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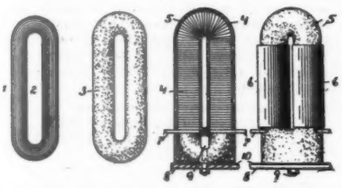
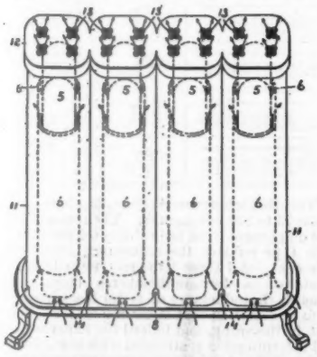
PROGRESSIVE ELECTRICAL INVENTIONS.

IMPROVEMENTS IN ELECTRIC HEATERS.

The application of a transformed alternating current to heating apparatus has been referred to heretofore in these columns. Several independent inventors have been addressing their energies to the solution of this attractive problem in a way which will render results most efficient for commercial uses. Several patents have been issued

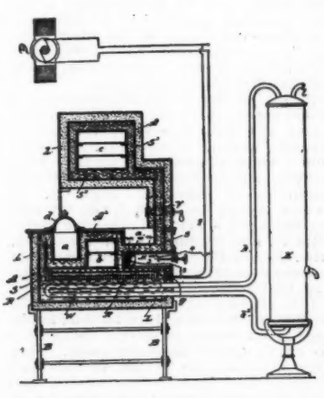


lately. One of these, illustrated in the accompanying engraving, is the invention of Charles H. Talmage, of Kansas City, Mo. Mr. Talmage builds up a laminated core, composed of annealed iron wires or strips, as shown in the detailed figures of this engraving, and embeds these in a mass of plaster of paris, as shown at 3, winding the primary coil around the core as shown at 4, enclosing the whole of this in an envelope of adherent plaster of paris as shown at 5, and then mounting on each end a sleeve of sheet iron as shown at 6. When alternating currents are passed through the primary coil, induced currents are developed in the bands of sheet iron 6, which form a closed circuit of a single turn for the secondary or induced current. A current of very low electromotive force but of very great quantity is developed in the sheet iron sleeves 6 which heats them, the heat being utilized to warm the walls of the radiator 11, in which the transformer is placed. Suitable openings at the top and bottom of the radiator are provided to create a circulation of air from bottom to top, the air passing in transit over the heated surface of the sleeves 6. The radiator just described is intended more particularly for house warming, car warming, or similar purposes. The inventor also contemplates



the use of electricity as a heating agent in cooking, and in adapting it to this use mounts the heaters constructed in substantially the manner described, in a suitable oven provided with a receptacle for the materials to be cooked.

An application to the same use has been made of the direct current by Mr. Ernest Abshagen, of Chicago, who works out the problem in a very different, though no less attractive, manner. Mr. Abshagen's heater is designed for cooking purposes and for heating water for domestic uses, as illustrated in the engraving, where an iron receptacle given any desired shape so as to provide the proper ovens *a*, *b*, *c* for cooking, forms an enclosing chamber for oil. In the lower part of the apparatus is a resistance coil, indicated at R, which is connected in circuit with a source of energy, as a dynamo electric machine, or with a line wire connected to such a machine. The current in passing through the resistance coil raises it to a high heat and the oil being in intimate contact with the resistance wire is raised in temperature and by its circulation produces a substantially uniform degree of temperature throughout the whole apparatus. In order to compensate for the expansion of the oil under an increase of temperature, a sliding piston M is provided, which operates upon a circuit closer and short circuits the resistance coil when the oil has reached a definite temperature or a

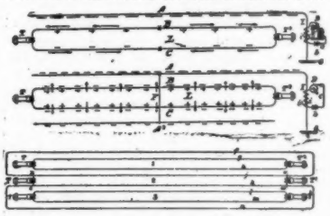


definite degree of expansion. In the oil chamber may be carried a pipe W, forming part of a conduit for water to the boiler K, whence it may be drawn off for domestic uses as desired. The entire apparatus is enclosed in an outer envelope, between which and the iron containing vessel for the oil, is placed some non-conducting material, such as asbestos, to prevent waste of heat by radiation. A portion of the surface of the apparatus indicated at A^1, may be directly exposed for culinary operations, which could not be conveniently performed in an oven. A cut-off V, is provided to cut off the oil in the upper part of the apparatus when the oven *c* is not in use.

Mr. Abshagen has also designed another form of heater operating on the same principle as that just described, so far as the development of heat is concerned, but designed especially for heating water or generating steam. In this device the oil chamber is surrounded by an auxiliary jacket, the space between the two being filled with water; the same provision for the expansion of the oil and for regulating the degree of heat by means of the adjusting screw m^2 and sliding piston M, just described, is provided.

REDUCING INDUCTIVE DISTURBANCES IN TELEPHONE CIRCUITS.

Readers of the ELECTRICAL REVIEW are familiar with the ingenious methods devised by Mr. John J. Carty, of New York, for the reduction of the disturbing inductive effect in telephone wires. Mr. Carty has lately patented a system for freeing a metallic telephone circuit from the disturbing effect due to the greater static induction on one side of the round metallic circuit than on



the other side. The principles of the invention will be understood from the accompanying engravings, in which Fig. 1 illustrates how the two sides of a round metallic circuit, B, C, may be electrostatically charged with electricity of different sign by a disturbing wire A, over which an interrupted current may be passing. If the wire A, at any given moment, be charged with a minus potential, then the near wire B will be charged directly with a plus potential and the remote wire C, being charged in turn by the wire B, will be of the same sign as the original charging wire A, thus creating current in its circuit. To overcome this difficulty, Mr. Carty proposes to divide the charging circuit, and place one branch on each side of the telephone circuit, thus causing the two wires to create opposing electrostatic disturbances in each wire and preventing any flow of current due to electrostatic action in the telephone circuit. When a series of telephone circuits are arranged parallel to one another, as shown in the final diagram, a wire may be carried from the middle circuit around the outside of each of the outer circuits, this arrangement having a similar effect in destroying the electrostatic action to those described above.

The Wires of Boston.

It is estimated that there are over 5,000 miles of overhead wires in Boston, 525 miles of which belong to the fire alarm department. Of this amount of wires a large percentage is known as "dead wires," and Superintendent Flanders will at once begin the work of removal. The fire alarm system of Boston was the joint invention of Dr. W. F. Channing and Prof. M. G. Farmer, both of whom are now living. The system was put in operation April 28, 1852, and, it is said, was the first electric fire alarm system in the world.

Diagnosis by Telephone.

Patient (through telephone)—Are you there?

Doctor (ten miles off)—Well, what is it?

Patient—Beastly cough.

Doctor—Let's hear.

Patient—Hum, hum, hum!

Doctor—Oh, all right. Take ten chlorate lozenges and you'll soon get well.—*N. Y. Herald.*

VIEWS, NEWS AND INTERVIEWS.

Since Henry Villard's return from Europe, he has persistently and successfully avoided being interviewed by reporters. The other day he dropped into Milwaukee to look after certain of his interests there. Mr. Villard was accompanied by Mr. David S. Wegg, who is said to be one of his trusted lieutenants.

"What is being done with regard to consolidating the Villard electric light companies and street railway companies in Milwaukee?" Mr. Wegg was asked by a newspaper man.

"Within 30 days," was the reply, "the consolidation will be consummated."

"Will the different interests all be consolidated into one company?"

"So I understand. The step is necessary, I believe, in order to permit of improvements." Mr. Wegg referred to the project of issuing consolidated bonds and transforming the street railways into electric systems.

"Cable cars will never be run on Broadway," was the prediction of Mr. Stephen D. Field. "I think that electric cars, run on the underground conduit system, will be the next motive power we shall see on this crowded thoroughfare."

"All this talk about free telephones in '93 is the veriest bosh," said a "hello man," the other day. "Why are you a telephone subscriber? Because you can reach the people you need to reach by subscribing to a telephone exchange. Just for the sake of argument, suppose that every patent owned by the American Bell Telephone Company expired to-morrow. Some one has a lot of telephones manufactured, wants to start an exchange, comes to you and asks you to become a subscriber. The first question you ask him is, 'Who else have you? Who can you connect me with?' He will tell you that Smith and Brown have said they would take telephones. 'Well,' you say, 'when you get Smith and Brown and about 500 more men with whom I have to do business, come to me and I'll subscribe.' That would be the embryo manager's experience with every man he tackled. When it comes to reducing rates, who is in a better position to do so than the Bell Company?"

"It is an indisputable proposition," remarked Col. Henry C. Davis, ex-president of the New York Electric Club, "that if a certain volume of business requires for its successful transaction a certain amount of circulating medium, when the volume of business increases, the circulating medium must be increased in the same ratio. The business of this country has grown enormously in the past few years and the increase in circulating medium has not been augmented proportionately; hence the stringency in the money market."

"The genius of street railroading," said Mr. John Stephenson, the oldest street car builder in the United States, "is in disintegrating the masses. Rapid transit can be best accomplished by using small carrying units and enough of them. And that is why I think the electric car of the future will be light, strong, not large and run on a four wheel truck with good running gear and fixed wheels. It is a mistake to build electric cars large and put them on six or eight wheel trucks. As long ago as 1834-6 it was proven by me, here in New York, that the eight wheel car was unsatisfactory. Running electric cars in trains is also a mistake, to my mind, for the reason first mentioned."

Inductance and Its Proposed Unit the Henry.

BY A. E. KENNELLY, BEFORE THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, NEW YORK, DECEMBER 16, 1890.

Perhaps the greatest discovery of Faraday's long career of scientific research was that of electro-magnetic induction in the year 1831, when he first brought to light the influence exerted by a magnet or a current upon surrounding matter when subjected to a change of magnetic potential. Oersted had shown that a conductor carrying a current exercised electro-magnetic influence at a distance, and Ampere had enunciated those simple and beautiful laws this influence is admitted to obey; but Faraday's discovery was a great step; it revealed the action of magnetic force in apparently empty space; it inaugurated that deeper insight into the mechanism, still only dimly guessed, which connects matter with all other matter in space; and it invested the all pervading ether with a dignity and power that, in the hands of many great men since his time, has probably paved the way for our future comprehension of magnetism, gravitation and radiant energy, while making the hypothesis of action-at-a-distance a mere mathematical conception and process of thought.

The development of this discovery of electro-magnetic induction has practically created electrical engineering, for it is to machinery operating by electro-magnetic induction that we owe nearly every branch of electrical industry except, perhaps, telegraphy, the forerunner of all; and the condition of modern electrical engineering is such that the units and nomenclature relating to steady currents and permanent magnets is insufficient for practical requirements, and the conditions developed by variable currents and magnets demand the establishment of practical engineering units for the purposes of convenience in expression and computation.

Foremost among these required units is that of inductance, or, as it is commonly called, the co-efficient of induction. This inductance is a property fully as essential to every electric conducting circuit as resistance and electro-static capacity, and the inductance of a circuit when conveying variable currents is often a far more important factor in regulating the flow than the ohmic resistance. In fact we know that Ohm's law does not apply to a circuit so long as the current is unsteady, unless the inductance of the circuit or the counter electromotive force it involves be introduced into the expression.

In conformity with the conventional and so-called absolute units of electro-magnetism an inductance is a length, and theoretically can always be computed from the geometrical relations of a circuit; that is to say, if the distance of each point from all other points of a circuit be measured or inferred, in inches or centimetres, the inductance of the circuit will be some definite number of inches or centimetres, capable of being determined by a possible if not a convenient process of summation. If the circuit, however, be associated with iron or other magnetizable matter, then the magnetic permeability of the environment will enter the terms of summation as a multiplier. In the absolute centimetre-gramme-second system of units inductance will be necessarily expressed in centimetres, and the centimetre is thus the natural scientific unit, although unsuited to the requirements of electrical engineering.

It may be well to notice that inductance is only conventionally and, perhaps, not essentially a length. Prof. Rücker has pointed out* that the multiplication of the permeability factor with the length factor is always tacitly, if not expressly, involved, even when the circuit considered is far from magnetizable matter in the ordinary sense; that is to say, when residing in a medium of unit permeability, and, therefore, the nature of inductance is not merely length, but length multiplied by permeability, while physics has not yet decided whether permeability is the simple numerical factor at present assumed, or a function of length, mass and time. Until this question is settled, the real nature of inductance must be considered as doubtful, and the fact that inductance will probably, in any event, be always measured by lengths is no more validly an argument as to its nature, than the usual determination of a body's mass by the earth's gravitational force upon it is an argument that mass is a force. However, the question is one of theory only, and does not affect the consideration of the practical unit.

As has been pointed out by Dr. Sumpner, †there are no less than three ways of defining the inductance of a circuit, or a portion of a circuit, and the three definitions are equivalent when the permeability of the magnetic medium is unity, but are not generally equivalent in the opposite event, being then only related in a definite manner by the magnetic properties of the medium. In other words, the inductance of a hollow solenoid of copper wire, placed in a vacuum and far from all iron, has the same numerical value in each of the three definitions, but if an iron core be inserted in it, its inductance will depend upon the definition selected, and will only be capable of interpretation from its value in one to its values in the others, by taking into account the characteristic permeability curve of the iron, and the conditions of the measurement.

For convenience and general use, however, the secondary definition of Sumpner and Fleming* is probably the best to adopt, and valuations in the other two can be reduced if necessary to this when the data for so doing are available.

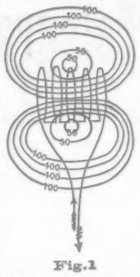


Fig. 1

The inductance of a circuit, or portion of a circuit, is then the ratio between the total induction through it to the current producing it. Thus taking a simple helix of five turns carrying a current of two units, and assuming that 1,000 lines of force,† passed through the central turn, of which owing to leakage, only 900 thread the next adjacent on each side, and again only 800 through the end turns, there would be 800+900+1,000+900+800 or 4,400 linkages of lines with the wire, and this being with two units of current there would be 2,200 linkages with unit current, and, consequently, the self inductance of the helix would be 2,200 centimetres. (Fig. 1.)

The fact that such helices are used in galvanometers, and that the magnetic force at any point within them is admitted to be proportional to the strength of the traversing current, renders it evident that had the current in this case been one unit, 2,200 lines linked with the coil would actually have been produced. Supposing, however, that the helix had been wound upon an iron core, the total number of linkages with the same two units of current would have been greatly increased, perhaps twenty-fold or to 88,000, and the induction then by the same rule would be 44,000. In this case one unit of current would not in all probability reduce the number of linkages to 44,000, the exact number would depend upon the characteristic curve of the iron core, and the degree of saturation, so that it would now be necessary to state the conditions of the measurement along with the result, in order to convey a clear and definite meaning.

It appears anomalous at first sight to state the above inductances in centimetres when they are derived from the number of lines of force, but it is to be remembered that the total number of linkages is divided in each case not by a mere numeric, but by a current, and this quotient can be proved to be a length in the existing system of dimensions.

In the same way the mutual inductance of two conductors is the ratio of the total induction through one of them to the strength of current in the other producing it. Suppose two coils of copper wire to be held in free space far from iron, and let one of them be traversed by a steady current of, say, four units. Of all the lines of force issuing from this coil, suppose 500 pass through the other coil. For simplicity, imagine the second or recipient coil to be composed of eight turns so disposed that the 500 lines pass through all in succession. There will then be 4,000 linkages of lines with that coil, and the mutual inductance of the two will be 4,000 ÷ 4 or 1,000 centimetres. It is interesting to notice that the same result would be reached if the second coil had the current and the linkages were counted in the first, the pair being mutually conjugated in this respect, provided they reside in a medium of constant permeability.

Thus far we have only considered the centimetre or absolute unit, whose unfitness for practical use is evident, since the smallest inductance that is at present known to engineering amounts to several thousand, while the average values met with are counted in millions of centimetres. It would, of course, be possible to name suitable units from the metrical system of lengths, but it is the proposal of this Institute to adopt the word henry as the practical unit, in honor of the man who, beyond all doubt, was among the foremost to extend the knowledge thus far possessed of self and mutual inductance.

If the selection of the practical unit were entirely free and subservient only to practical requirements, so that its magnitude should express ordinary values in digits with fewest decimals on the one hand or large numbers on the other, there seems most reason to believe that the thousandth of the earth-quadrant or myriametre would be the most eligible.

Proposed Name	Length	Number of Centimetres	Unit.
Henry	Earth Quad't	1,000,000,000	Pract. Unit
		100,000,000	
		10,000,000	
Millihenry	Myriametre	1,000,000	
	Kilometre	100,000	
	Hectometre	10,000	
Microhenry	Decametre	1,000	
	Metre	100	
	Decimetre	10	
	Centimetre	1	Absol. Unit

Of course, large iron machines, employing many turns of wire linked by dense magnetic fields, would have inductances more appropriately expressed in earth quadrants, which might then be termed the kilohenry just as we now have the watt and kilowatt, but there is one restriction which makes such a selection undesirable, and that is the hitherto unbroken system of practical units itself. This practical system is a subscheme of the great international C. G. S. system and especially planned for adaptability to practical requirements. It is derived from that parent system by the subsitution for the unit of length, 1,000,000,000 centimetres in place of one centimetre, and for the unit of mass and impalpable entity definite only in thought, the one hundred millionth of a milligramme in place of the gramme. By this substitution in the C. G. S. electro-magnetic units, we obtain the hitherto unbroken system of the volt, ohm, ampere, coulomb, joule, watt and farad. Even these units are not always the most convenient; witness, for example, the microfarad in common use, whose prefix is maintained simply in deference to the harmony of the system, for the farad is a capacity that exists only in imagination; the capacity of the earth itself being only about 700 microfarads, and of the sun, or rather a sphere having the apparent dimensions of the sun, being only about 76,000 microfarads. On the other hand, a proposition has lately been made to infringe the system by making the volt, the ampere and the watt ten times their present values on the ground of practical convenience.* However, at the present time, it would surely be unadvisable to attempt the precedent of infringing a system that has hitherto been supported by time, custom and international congress.

In this practical system the unit of inductance must be 1,000,000,000 centimetres. That is, an earth-quadrant or the distance from the pole to the equator, measured on the meridian of Paris. Strictly speaking, it is only the quadrant of the French standard earth, which is about one-hundredth of one per cent. shorter than the acknowledged actual earth-quadrant, according to the best determinations, but the fact of the latter being 10,001 kilometres instead of 10,000, is a matter of precision in definition only, and in no way affects the practical unit.

As regards the history of the subject, it would appear that prior to 1887, measurements and deductions were confined to scientific works, and were expressed in absolute units—centimetres. In that year, however, a paper was read before the British Institution of Electrical Engineers, by Messrs. Ayrton and Perry,† who invented and developed a practical measuring instrument for the measurement of inductance, who, aided by Dr. Sumpner, made important contributions to the literature of the subject, and who proposed a name, provisionally, for the practical unit. That name was the secohm, a contraction of second-ohm, implying the fact that the product of the two was the length equal to the practical unit. They drew attention to the fact that since the Paris Congress of 1884 had fixed the standard legal ohm as the resistance of a column of mercury at zero Centigrade, 106 centimetres long and one square millimetre in cross section, whereas the true ohm was in all probability 106.3 centimetres, or one-quarter of one per cent. greater, the inductances measured in the manner they suggested from seconds and legal ohms, would be in terms not of the standard earth-quadrant of 10,000 kilometres, but of legal earth-quadrants 9,978 kilometres in length. The difference practically is not very great, but to avoid error or confusion in definition, they advocated, provisionally, the term secohm in place of quadrant.

The Paris Congress of 1889 adopted the "quadrant" as the practical unit of inductance, defining it as 1,000,000,000 centimetres.

The practical range of inductances is second only to that of resistances, and the latter we know from a few microhms up to thousands of megohms. The smallest inductances are those of Hertz resonators, which descend to the order metres. Excluding these, however, the smallest are, perhaps, met with in measuring instruments intended to have negligibly small inductance, such as doubly wound resistance coils, Cardew voltmeters and the like. These descend to the order of decametres, and can generally be expressed as such without prefixing decimal points. It is evident that the term microhenry would suitably apply to their designation. At the other end of the scale we find large induction machines linking dense fields with many turns of wire, and reaching inductances of hundreds or even thousands of henrys. Intermediate between these limits there exists a large class of circuits, having many turns but little iron, or clad in iron with few turns of wire, and these seem to be best expressed by the term millihenry, equivalent to the myriametre.

With the object of setting forth the advantages to be derived from the use of this nomenclature, it may be permissible to adopt it provisionally in describing the measurements that follow. These measurements have been made on different types of apparatus at different times and by different methods, so that they represent mean values from several observations in many cases, but allowance must be made for the variations of standard and type.

In telegraphy, the inductance of an ordinary Western Union 140-ohm relay is about three henrys with the armature drawn well back, and nine henrys with the armature pressed against the poles; in the latter case, of course, the magnetic reluctance of the iron circuit is a minimum, and the same current in the coils causes three times as many lines to circulate through the iron. At the position of the armature in ordinary adjustment, the inductance is about five henrys.

The inductance of an ordinary standard 10ω relay is from 200 to 500 millihenrys, according to the position of the armature relatively to the poles.

The inductance of an ordinary sounder is similarly from 25 to 50 millihenrys. These inductances are the values obtained with only a few milliamperes through the coils, and since the path of the induction is largely through iron, the inductance varies with the strength of the current used. Practically, however, the variation is small within the range of currert at which instruments usually operate.

SUBMARINE TELEGRAPHY.

The inductance of a mirror speaking galvanometer of the ordinary type having 2,250 ohms was found to be 3.6 henrys.

TELEPHONY.

The inductances met with in the ordinary long distance telephone apparatus are as follows:

The call bell, 80 ohms and 1.4 henrys.

The magneto armature, 550 ohms and from 2.7 henrys with the plane of the coil in the line joining the poles to 7.3 henrys when the iron core joins the poles, the plane of the coil being then at right angles to the magnetic flux.

The induction coil primary, 0.28 ohm and 3.5 millihenrys.

Secondary, 164 ohms and 734 millihenrys.

The mutual inductance between the coils, 60 millihenrys.

TABLE OF INDUCTANCES OF COPPER ÆRIAL LINE WIRE PER KILOMETRE AND MILE, FOR DIFFERENT DIAMETERS AND ELEVATIONS ABOVE THE GROUND.

Diameter of wire.			Elevation above ground 400 cms. or 13.1 ft.		Elevation above ground 700 cms. or 23. ft.		Elevation above ground 1,000 cms. or 32.8 ft.		Elevation above ground 1,300 cms. or 42.7 ft.	
Centimetre.	Inches		Millihenrys or Myriametres.		Millihenrys or Myriametres.		Millihenrys or Myriametres.		Millihenrys or Myriametres.	
			per Kilometre.	per Mile.	per Kilometre.	per Mile.	per Kilometre.	per Mile.	per Kilometre.	per Mile.
0.10	0.039		1.986	3.196	2.109	3.393	2.170	3.493	2.232	3.593
0.20	0.079		1.848	2.974	1.960	3.154	2.021	3.252	2.083	3.353
0.30	0.118		1.766	2.842	1.878	3.022	1.939	3.120	2.000	3.219
0.40	0.158		1.709	2.750	1.821	2.930	1.882	3.028	1.943	3.127
0.50	0.197		1.666	2.681	1.778	2.860	1.839	2.958	1.900	3.057
0.60	0.236		1.632	2.627	1.744	2.806	1.805	2.904	1.866	3.003
0.70	0.276		1.604	2.581	1.716	2.761	1.777	2.859	1.838	2.957
0.80	0.315		1.581	2.544	1.693	2.724	1.754	2.822	1.815	2.920
0.90	0.354		1.561	2.512	1.673	2.692	1.734	2.790	1.795	2.888
1.00	0.394		1.543	2.483	1.655	2.663	1.717	2.762	1.778	2.860

The Bell telephone receiver, 75 ohms and from 75 to 100 millihenrys. The removal of the diaphragm from an ordinary telephone of this type reduces the inductance about 35 per cent. All these inductances are to currents of a few milliamperes only. As regards the inductance of aerial line wires, it is to be regretted that measurements are not yet forthcoming, and indeed the experimental determination is attended with some difficulty, owing to static capacity and imperfect insulation. In the absence of direct measurements, theory indicates that the inductance of overhead copper wires depends upon the elevation above the ground, as well as upon the diameter. In the case of iron wires as used in telegraphy, the permeability of the iron enters as an additional factor. The above table of inductances for copper wires,

(Continued on page 216.)

Philosophical Magazine, February, 1889. Fifth series, vol. 27, p. 104.

† *Philosophical Magazine*, June, 1888. Fifth series, vol. 25, p. 453.

* "The Alternate Current Transformer," by J. A. Fleming, vol. I. p. 55.

† The term line of force here is used in the sense of a line of induction; the distinction being necessary when the lines pass through iron.

* *The Electrician*, of London, Sept. 19th, 1890, p. 558, Report of British Association Discussion.

† *Journal of the Institute of Electrical Engineers*, London, April, 1887, vol. 16., p. 391.

The Berliner Gramophone.

Mr. Emile Berliner, of Washington, D. C., exhibited and explained his gramophone to a large audience at the rooms of the American Institute of Electrical Engineers, the evening of December 16. The instrument was arranged with a funnel or loud speaking device. While the work of the machine in reproducing a wide range of sounds was excellent, the quality of the reproductions could have been improved had a smaller or differently shaped funnel been used. When individual ear-tubes were employed the results were much better.

The main point of difference between the gramophone and the phonograph is that in

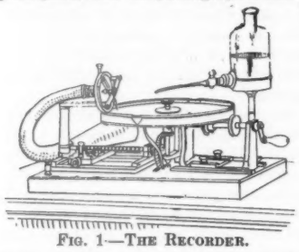


FIG. 1.—THE RECORDER.

the former the resistance between the style and the recording medium is constant, while in the latter it is variable. This may be expressed in another way by saying that the sound record of the gramophone is a curve lying in a horizontal plane, while that of the phonograph lies in a vertical plane.

The instrument is shown in the accompanying illustrations, for which we are indebted to the New York *Sun*. There are two distinct parts, the recorder and the reproducer. A flat disk of zinc covered with a thin, fatty film, is the recording medium. Vibrations of a diaphragm made of ivory or mica operate the style which traces the phonograms upon the disk by cutting an irregular line through the fatty film to the

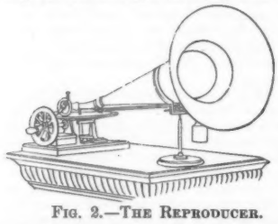


FIG. 2.—THE REPRODUCER.

surface of the zinc. The disk is then placed in a chromic acid bath, which bites the lines into the metal.

When operated, a prepared disk is mounted upon the turn-table of the recorder, and revolved by a friction wheel turned by hand. The sound waves proceed from the speaker through the mouthpiece to the diaphragm, which is set vibrating, thus operating the style. A carriage moves the style toward the center of the disk, the record being made in a spiral line. During the recording process, alcohol is dropped upon the disk from the tube connecting with the bottle shown in Fig. 1. When the record is finished, the disk is washed in water and placed in the chromic acid bath to be etched. The etching pro-

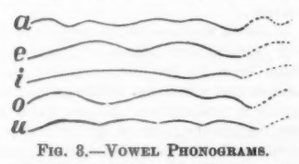


FIG. 3.—VOWEL PHONOGRAMS.

cess occupies from 15 to 20 minutes. It is possible to make copies from an original disk.

The reproducer is very much the same kind of a machine as the recorder. A disk holding a record is placed on the revolving table, the style placed in the etched groove and the table revolved. The style vibrates a diaphragm and the sound, increased in volume by the funnel, is reproduced.

It would seem that the gramophone was well adapted for use at entertainments, especially in reproducing music. The instrument could never compete with the phonograph in practical office work, owing to the long time required to fix the sound impression upon the disk.

THE FINANCIAL END OF IT.

Mr. Edward Atkinson, in *Bradstreets*, contemplates an extension of the methods of granting clearing-house certificates.

The trend of financial conditions is towards inflation, and the international tendency is towards bi-metallism.—*Boston News Bureau.*

Senators Aldrich and Hawley think that one of the most serious elements in the present situation is the fear of ill-advised financial legislation by Congress.

Senator Sherman, whose views on financial matters are of especial weight, does not regard the increase of the volume of the currency as a panacea for the existing financial evils, but says that, while there should be no decrease of the currency, too great an increase of it would do more harm than good.

The directors of the Edison Electric Illuminating Company, of Boston, in addition to the one per cent. quarterly dividend, declared a dividend of five per cent., representing surplus earnings, payable in certificates convertible into stock at par whenever the company shall increase its capital stock beyond the present authorized amount, or redeemable in cash, at par, at the option of the company. Until so converted or redeemed, these certificates will bear interest at the same rate, and payable at the same time, and in the same manner as dividends may be paid on the company's capital hereafter. These dividends will accrue to stockholders of record January 2. Convertible certificates will be delivered on and after February 2. Transfer books re-open January 21.

Among the numerous very interesting and highly problematical causes of the recent financial flurry in Wall street, says a writer in the New York *Press*, I heard this one given: "Jay Gould has wanted the Postal Telegraph to consolidate with the Western Union and stop competition for a long time. He hammered the market down to get possession of Postal Telegraph, and he will keep it down till he gets what he wants, and that you may bet on." When the Wall street man who delivered this oracular declaration had concluded, a quiet looking business man said: "See here. I have a district messenger call of the Postal Company in my house on Forty-eighth street. The other night I stopped at their office, corner of Sixth avenue and Forty-sixth street, to send a telegraph message. They told me that they no longer received telegraph messages, but recommended me to the Western Union telegraph office just across the way. I guess that Jay Gould has got hold of the Postal already."

The Sabold System of Grounding Electric Railroad Tracks.

Mr. Frank W. Sabold, of Albany, N. Y., has recently secured a patent for a new method of effecting the earth return of electric railway circuits. At present in this important part of electric track construction, the return circuit is generally made by means of the rails themselves; in some cases a supplementary wire is laid in the earth, but this plan is expensive, both in first cost and depreciation. This method also operates unfavorably towards other electrical interests, as the railway line practically constitutes a metallic circuit, carrying a heavy current, with one side leaking to

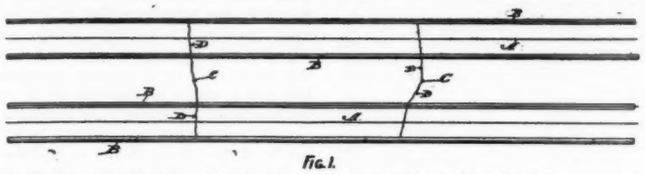


FIG. 1.

earth. Neighboring telephone circuits are badly effected by conduction of these leaking currents, being often rendered completely inoperative unless disconnected from the ground and made into metallic circuits.

Mr. Sabold's invention consists in connecting electrically each length of track-rail to an earth plate or metal bar sunk deeply into the earth at the center of the track. By this method every track-rail is thoroughly grounded; the ground connection being made with the damp earth below the surface, the escape of the current into neighboring circuits by conduction is avoided. Figs. 1, 2 and 3 illustrate Mr. Sabold's idea.

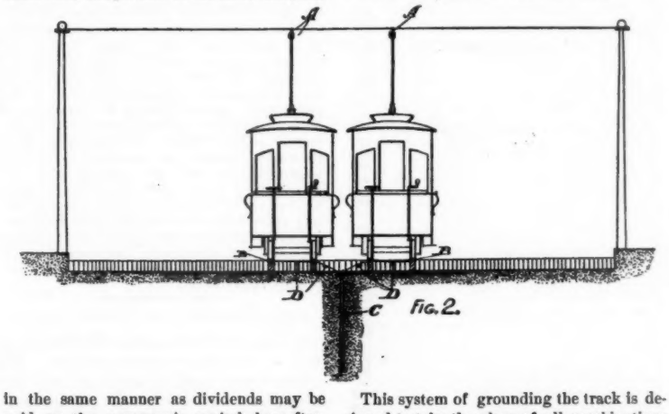


FIG. 2.

This system of grounding the track is designed to take the place of all combinations of wires and rails as part of the return circuit, and it has been found to be, in practice, an improvement over the most elaborate and expensive system of track wiring. As can be understood from the above description, the new method is simple, and it has the additional recommendation of cheapness; the cost of applying it being about $50 a mile.

Several applications of the new system have already been made. In Troy, N. Y., where the interference of the telephone circuits by the working of the electric railway had become a serious trouble, the telephone lines were restored to their normal conditions of working by the introduction of the Sabold system of grounding the track of the electric railway. The same good results have followed the application of the system to the lines of the Albany Street Railway Company, in Albany, N. Y. The track of the Watervliet Railroad, operating between Albany and Troy, is now being equipped with the Sabold grounding system, and it is expected that other electric railways will adopt this obvious improvement in track construction as soon as its nature becomes more generally known.

Mr. Sabold has pending applications for patents in Canada and in the principal countries of Europe.

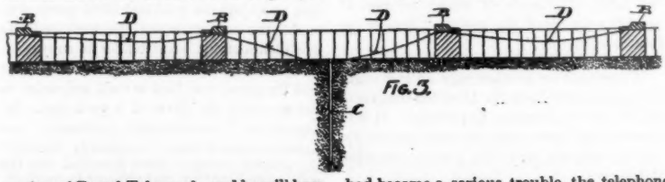


FIG. 3.

Saco, Me.—Cambridge Accumulator Company; capital, $500,000.

Chicago, Ill.—The Electrical Machine Company; capital, $5,000.

St. Louis, Mo.—The Stevenson-Hoggson Electric Company; capital, $100,000.

Corpus Christi, Tex.—Corpus Christi City Railway Company; capital, $100,000.

Coudersport, Pa.—Citizens' Gas, Light and Heating Company; capital, $50,000.

Du Quoin, Ill.—The Du Quoin Electric Light, Power and Heat Company; capital, $10,000.

Philadelphia, Pa.—Equitable Construction and Engineering Company; capital, $50,000.

Marquette, Mich.—Lake Superior Electrical Construction and Supply Company; capital, $200,000.

Chicago, Ill.—The Chicago Incandescent Light and Wiring Company; capital, $1,000. Incorporators, L. B. Scott, C. P. Emmons, G. N. Lyman.

De Soto, Mo.—The Consumers' Electric Light and Power Company; capital, $50,000. Incorporators, Ward Roberts, Bison J. Arnold and Otis M. Munroe.

Chicago, Ill.—Village Electric, Gas Light and Railway Company, to construct electric plants, etc.; capital, $50,000; incorporators, William H. Porter, Charles O. Reed and Gilbert E. Porter.

Oswego, N. Y.—People's Electric Light and Power Company; capital, $75,000. The incorporators are Max. B. Richardson, A. S. Page, A. H. Failing, Geo. N. Burt and Martland E. Graves.

Salt Lake City, Utah.—The East Bench Rapid Transit Company; capital, $50,000. Directors: D. P. Anderson, J. R. Smith, George Crismon, Harvey Hardy, J. W. Little, W. H. Irving, C. F. Loofbourow, C. E. Wantland, Boyd Park.

Chicago, Ill.—Auburn Park Electric Light, Power, Heat and Railroad Company; capital, $30,000; to furnish electricity and establish an electric street railway in Cook county. Incorporators: B. F. Cronkrite, W. E. W. Johnson, George E. Farley.

New Albany, Ind.—The Electric Lighting, Heat and Power Company, of New Albany; capital, $100,000. The incorporators are M. V. Mallory, Paul Reising, Solomon Ruthenburg, John Rauschenberger, W. A. Loughmiller, John S. Briggs and Marcus Ruthenburg.

New Bedford, Mass.—The Pope's Island Manufacturing Company; capital, $50,000. David B. Kempton, president; H. Wilder Emerson, treasurer. The company manufactures metals, alloys and primary and storage batteries. The directors of the new corporation are: William A. Bassett, Charles A. Gray, David B. Kempton, Henry C. W. Mosher, H. Wilder Emerson, James S. Howard.

Trial of Electric Meters.

The city of Paris had arranged for a trial of electric meters last year, which was postponed till the present year. A certain number of sets of apparatus had been sent in and some trials had taken place. There are now 50 sets of apparatus, which have been sent in for competition. The jury which is to examine the various apparatus will be composed of nine members, of whom five are chosen by the Municipal Council, and trials of the apparatus, we understand, are now in progress. A large number of American meters are included.

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THE GREETINGS OF THE SEASON TO THE BODY ELECTRICAL AND ITS INDIVIDUAL MEMBERS!

Every time Christmas comes on the 25th of December, it reminds us of that old holiday fable of Æsop's, of which we can at present only recall the moral: "Now is the time to subscribe!"

We publish on another page an important communication from the Director-General of the World's Columbian Exposition. It is of especial interest to the electrical fraternity, and we bespeak for it the prompt attention it deserves.

Major Moses P. Handy, of Philadelphia, is the right man in the right place as manager of the Press Bureau of the World's Fair. A thorough journalist was needed, and we are glad one was found willing to accept this highly important work.

The unusual storms of the past week have caused much trouble for those in charge of overhead wire construction. The heaviest damage reported was done in Pittsburgh, where the telephone, police and fire alarm telegraph systems were badly crippled for a few days.

The St. Louis *Globe-Democrat* prints from one to two columns of electrical news at frequent intervals. The articles are well selected from the leading electrical journals. They are not re-hashed by the horse editor, but are reprinted in full with credit to the journal quoted from at the head of each article.

The ELECTRICAL REVIEW has received, during the past three months, something like 1,000 requests for sample copies, which is a very satisfactory evidence of an increased interest in electrical matters, as well as in this journal. These requests we have been pleased to comply with, with but one exception. Some one writing from Rochester, Michigan, and who states that he is "very much interested in electrical matters, and hence anxious to see your paper," fails to sign his name. Now, we hope he will see this notice, and if he does see it, he will see a copy of the paper; and he may not want to see another, but we think he will. Anyhow, we shall be pleased to send him a sample copy if he sees this and will send us his name.

No more pat proof of the scope and extent of progress in the electrical field could be brought forward than a careful scrutiny and comparison of last week's issues of the ELECTRICAL REVIEW, *Electrical Engineer* and *Electrical World*. Such an investigation would adduce the fact that although all three of the journals named are published in New York, yet, with one minor exception, the illustrated matter contained in each was entirely different from that of the others. The noteworthy features in the ELECTRICAL REVIEW were an illustrated article describing the newest thing in arc lamps, a description of a visit to one of the great electric light stations of the country, articles on electro-magnetic radiation and testing the centrality of cable cores, both fully illustrated, a short but interesting account of the electrolytic administration of medicine, a chatty column of every-day news, our Washington letter, which covered, in a most thorough manner, the electrical needs and appropriations of the government for the ensuing year, general correspondence, an account of one of the largest storage battery enterprises ever inaugurated in America, important patent news—and so we could go on; but the REVIEW of last week—and of every week—needs to be seen to be thoroughly appreciated.

ELECTRICALLY WELDED COINS.

General Berdan has proposed a novel solution of the silver coinage problem. His scheme is to make a dollar of gold and silver, mechanically combined, by first making a silver coin worth 25 cents, with a hole in the center, and then pressing into the hole a plug of gold worth 75 cents. On the face of it, this seems a good idea, as it would do away with the objection raised by all to the size and weight of the silver dollar and the minuteness of the gold dollar. In other words it is an average—a concentration of advantages.

But the out of the matter lies in the "mechanically combined" detail, which is more important than at first sight would appear. It will be a delicate and difficult task to so join the gold and silver parts as to enable the coin to stand the wear and tear to which metallic legal tender is subjected.

As usual, Electricity, Goddess of Power and Progress, can lend her aid and assist to practicability the germ of a good idea. If, instead of "mechanically combined," we substitute the words "electrically welded," the scheme becomes more practical, and the coin more beautiful and cheaper to produce. By electrically welding the gold and silver blanks together and then subjecting the composite piece to the impression of a die, a coin with slightly concave surfaces could be produced with the great advantage that the welded joint would be the strongest portion. Concaving the faces of the coin would throw the maximum wear on the outer ring of silver. Such a scheme brought to perfection would be bi-metallism with a vengeance.

As a design for the obverse of this new coin we would suggest an ideal representation of the Goddess of Electricity. Columbia would thus be given a well-earned rest, and the coming power would be symbolized and immortalized, although such actions might offend the pretty Philadelphia girl who posed for the profile of Columbia.

AMERICAN INSULATED WIRE.

In a letter referring to ship wiring for electric light, signed by Mr. Rankin Kennedy, printed in the issue of December 5th of our London namesake, we find the following passage: "I have seen their (American) electric light wires and wiring, and on comparing them with the products of our leading makers on this side, come to the conclusion that we are considerably better off than they are. A wire equal to the best of our vulcanized rubber insulated wires, is not to be got on the other side. The lead-covered wire *without a continuous insulation* of vulcanized rubber is a failure on board ship. Sea water is certain to get in between the wire and the lead pipe where there is no rubber insulation. In fact, if it were not for their high import duty, it would be better for American contractors to import their wires for ship lighting."

We think that these statements are open to serious question, and more—to explicit denial. The insulated wire industry in this country has only attained large proportions during late years, and this branch of manufacture is one above all others where long and often dearly bought experience is an important element in the successful production of high class material. In several cases the experience has long ago been acquired, and we could name several important firms belonging to New York city alone who have for years been turning out rubber insulated wire fully equal in durability and insulating properties to the best that is produced on the other side.

The insulated wire industry is looked upon as such a profitable field that many new concerns have entered the market, and competition has become so eager that in some cases cheapness is studied to the detriment of the durability of the product, and there is no doubt that there are insulated wires being put forth whose covering will not stand the test of time. Probably, Mr. Kennedy has seen some of these and formed his opinion from such inspection. On the other hand, there are many classes of wire made in this country that stand the test of time, rough usage and adverse surroundings uncommonly well, and these Mr. Kennedy has apparently overlooked.

We do not wish to believe that much ship wiring is done in this country with lead covered wire having only fibrous insulation. It is too often the case that sound construction is sacrificed through under-bidding in order to obtain contracts, and cheap wire is put in so as to make a profit on the job. We have previously expressed our opinion on such work in no uncertain terms and can only reiterate the wish that jobs of this sort may speedily prove the ruin of the contractors who are responsible for them and the blot on the reputation of American electrical construction.

That such work is the rule on this side, however, we emphatically deny, and the statement that there is any necessity for us to import insulated wire, duty or no duty, in order to make our ship-wiring safe and durable, can only be received with amazement and derision.

BOOK NOTICES.

"Journal of the Franklin Institute," for December, 1890, has been received.

"The American Meteorological Journal," for December, 1890, has been received.

"Bulletin de la Société Internationale des Électriciens," for November, 1890, has been received.

Scribner's Magazine for January opens the fifth year and ninth volume of a periodical, which from its first issue was a popular success, and which has continued to grow rapidly in public favor. Its prospectus for 1891 contains the names of a number of contributors who are unrivalled in their special fields—men like Henry M. Stanley, James Brice, Sir Edwin Arnold, and Robert Louis Stevenson. The readers of the "Railway" and "Electric" series will be glad to know that a similar series on "Ocean Steamships" is promised.

Christmas comes but once a year, but you get 365 opportunities a year to subscribe for the ELECTRICAL REVIEW, if you haven't done so already. If you are not a subscriber, and this reaches your eye, just save three dollars out of your presents and send it to us. We will invest it for you and pay dividends every week. "Now is the time to sub——."

CORRESPONDENCE.

OUR WASHINGTON LETTER.

The Secretary of the Navy has made a report calling attention "to the advantage of providing a place in the ranks of the naval militia for persons of special acquirements demanded by the naval service, but of a character somewhat outside of the ordinary scope of professional training. The extensive employment of electricity in its applications on ship-board makes it necessary for naval officers to acquire a certain amount of electrical knowledge, but it is impossible for all, or even for any great number of them, to become expert electricians, nor is it desirable that they should do so at the expense of other branches of their profession of more pressing importance. To meet this want, it is suggested that a corps of naval electricians be established in the different states that have created a naval militia, to be attached to this militia and to receive the naval training which it is the great object of the militia to give. By this means a corps of electrical specialists would be organized, familiar with the needs and usages of the naval service, and the extended applications of electricity to naval vessels would be rapidly developed in time of peace as well as in war. In the latter contingency the corps would be especially valuable in fitting out new vessels with electrical apparatus, and in taking charge of the electrical plant on board ships in commission. The number of officers available in an emergency would thus be increased, as those now detailed to electrical work could be assigned to other duties, and their work could be carried on by the experts of the naval militia."

Bids were Opened at the Navy Department on the 16th inst. for the installation of an electric light plant at the Navy Yard, New York. The proposals were to furnish and put up, in complete working order, two dynamos, each of which is required to produce a current sufficient to work thirty 2,000 candle-power arc lamps, with all necessary appliances and belting to connect the engine; 60 double carbon lamps placed on iron posts, and an extensive system of overhead lines built in the superior manner required for such government work. The department is to furnish a Westinghouse steam engine to operate the plant. The bids were as follows: Brush Electric Company, Cleveland, $21,100; Thomson-Houston Electric Company, $20,550; Fort Wayne Electric Company, $13,700; Western Electric Company, $4,350.

The Postmaster-General has been investigating the use of pneumatic tubes by the post offices in Berlin, Paris, London and other cities in Europe, and favors their introduction into the service of his department. He recommends the construction of a system of tubes to connect the executive departments and the Senate and House of Representatives with the Washington city post office as the first experiment in this direction, and that the system may then be extended to the sub-stations and post offices of large cities. He especially desires to see a pneumatic system working perfectly in Chicago by the time the World's Fair is in progress, so that the postal exhibit there would really show this high development of the service.

A Measure Pending in the House of Representatives will, if passed, stop the construction of any more electric wire conduits until Congress receives the report of the recently appointed commission, which may be looked for about a year hence. The commission has been requested to prepare rules for the wiring of all public and private buildings in the District of Columbia. G. C. M.

Washington, D. C., Dec. 19, 1890.

OUR BOSTON LETTER.

A New Accumulator will soon be ready to place on the market. It is the invention of Mr. Joseph T. Bradbury, of Lowell, Mass.

The Somerville Electric Light Company, of Somerville, Mass., has increased the capacity of its station from 500 to 1,000 horse-power.

The Milford, Mass., Electric Road will probably be completed and equipped by the second week in January.

The Burlington, Vt., Electric Light Company intends soon to increase its capital stock for the purpose of making extensive additions to its station.

Mr. Fred. J. Pettingell, of the Pettingell-Andrews Company, this city, has just returned from a long business trip in the West. He reports a successful tour, having secured many new customers.

The New England Printing Telegraph Company has completed its connections between New York, Providence and this city. The company is rapidly extending its service, and will, at an early day, have its meritorious system firmly established in nearly every city and town in New England.

Massachusetts Institute of Technology.—The Class of '93 had a very successful dinner Friday evening at the Parker House, this city. The Civil Engineering Society held a meeting Thursday evening, and among the interesting papers read was one on the "Utilization of Niagara," by Mr. A. L. Goetzman.

Messrs. McKinney & Waterbury, the well-known manufacturers and designers of electric light fixtures, this city, have fitted up the new Suffolk County Court House with combination (electric light and gas) fixtures in polished iron and antique brass. These fixtures are from the firm's special designs, and cost many thousand dollars.

A Novel Electric Light Illumination attracts the attention and admiration of pedestrians who happen to be in the vicinity of the Parker House any evening after dark. The extensive front of the Houghton & Dutton building is illuminated every night with 1,000 or more incandescent lights in variegated colors. The firm's name and the words "Merry Christmas" in huge letters of crimson, blue and gold, intertwined with streamers of carmine bulbs, is an artistic piece of work, and presents a most beautiful picture. W. I. B.

Boston, December 20.

Wants $100,000.

Dudley Baldwin, Jr., is suing the Cowles Electric Smelting and Aluminum Company for $100,000 damages resulting from a broken contract. The defendant denies the contract and will fight.

A Prophecy.

Mr. Pedro G. Salom, secretary of the Consolidated Electric Storage Company, in a recent communication to the Philadelphia *Evening Telegraph*, says: "Even if the overhead system gains a temporary advantage by being introduced at the present time, the street railway company will be forced by the inevitable logic of events to adopt the storage system in the future. Those who are clamoring loudest for overhead traction to-day will ultimately be the most earnest advocates of storage battery traction."

A Christmas Greeting.

TO THE EDITOR OF ELECTRICAL REVIEW:

Please forward my ELECTRICAL REVIEW hereafter to the above address.

It has been my magical "accumulator" for years, and I feel like the electric eel (*gymnotus*) deprived of his electricity when your great weekly fails to energize my "motors."

Wishing you and your staff a Happy Xmas, I am, as ever, Your friend,

J. HARRIS ROGERS.

Washington, D. C., Dec. 18th, 1890.

PERSONAL.

William F. Sherman, the inventor of a number of electrical appliances, died at his home in Lowell, Mass., December 16th. He was 65 years old.

Mr. Charles Rhodes, father of Benjamin Rhodes, the well-known electric light manager, of Niagara Fall, N. Y., died December 17th in the 75th year of his age. Mr. Rhodes was an able and highly esteemed gentleman.

Mr. C. E. Yost, general manager, and Mr. Flemon Drake, general superintendent, of the Nebraska Telephone Company, both of Omaha, were visitors in the East last week looking into the question of underground wires. Their many telephone friends and others gave them a warm welcome.

The able and interesting paper read by Professor Edward L. Nichols, before the New York Electric Club, on "The Light of the Future," has created widespread comment. Copious extracts have been printed in the daily press and the full lecture has appeared in every technical paper of note.

A number of Mr. Cyrus W. Field's English friends sent him an illuminated address on the fiftieth anniversary of his marriage, December 2d. The address was also cabled to him and his wife. As a further memento of Mr. Field's connection with the first cable across the Atlantic, a piece of teak from the "Great Eastern" has been handsomely mounted as a walking stick for presentation to him. On the top a small sketch of the "Great Eastern' has been engraved, and on a band encircling the stick, "Portion of the 'Great Eastern,' broken up 1890. Cyrus W. Field, Esq."

The Government and the Telegraph.

SOME OF THE ABSURDITIES OF THE SCHEME —AN ABLE REVIEW BY OUR WASHINGTON CORRESPONDENT, WHO IS AN EXPERIENCED TELEGRAPH MAN.

The government's telegraph scheme has at last come before Congress and the people of the country. The bill prepared by the postmaster-general, which has been before the House Committee on Post Offices, in one shape or another, for about a year, was reported to the House on the 12th inst. by Mr. Evans, of Tennessee, and it is expected that it will be considered early in January. It failed to receive the support of the committee, which had spent a great deal of time listening to arguments for and against it, and was introduced by Mr. Evans on his own responsibility. It must now stand on its own merits. The postmaster-general, in his annual report, strongly urges its adoption and declares that he will advocate it with all possible persuasiveness. He says: "One idea has dominated the Department this year; to make the mails go faster, more safely and more frequently. The swiftest mail is not fast enough for all the needs of commerce and social correspondence. The conviction steadily grows on me that the post office should do more than employ fast mails and stage-coaches, and that the electric wires should carry letters." What General Wanamaker wants to do is to establish "a limited post and telegraph service," which he calls "a harmless, inexpensive experiment." He claims that this "experiment" will result in great benefit to the people of the whole country and that it will cost the government nothing. The bill provides for a partnership service, conducted by the post office department and a private company. The plan is to establish a new corporation, backed by all the prestige and power of the government, and allow it to do, on its own account, all the business it can secure, exclusive of the business done under the jurisdiction of the post office department in the incorporated cities and towns where free delivery service may be maintained, which the company is to do under a contract running ten years.

This scheme, regarded as an experiment, is too much; as an attempt to establish a permanent government telegraph it is not enough. If it is intended that the government shall simply try the telegraph experiment, which may prove a failure and have to be abandoned, then 10 years is altogether too long a period for the trial. If the post office department doubts its ability to determine in less than 10 years whether it is competent to conduct the telegraph business of the country, the country will be justified in believing that the department is not prepared to undertake the experiment.

The plan is open to grave objections. In the first place, nobody believes that it would prove to be simply an experiment; or that, if inaugurated, it would continue, for any length of time, to be a "limited service." It proposes to break down one monopoly by establishing and upholding another. It is unquestionably a strategic move towards an absolute governmental control of this means of "conveying intelligence," which, for some purposes, is superior to the mail service. And it is equally clear that the next move would be towards governmental control of the telephonic service, which, for some purposes, is superior to the telegraph. It is a significant fact that the most earnest and most consistent supporters of the measure are the socialists, and they are already preparing to attack the gas and electric lighting interests as the next thing to be absorbed by the national government.

This telegraph project is not based on reliable information concerning the practical questions involved in the undertaking. The proceedings before the committee of Congress have been, in no sense, an investigation of the subject. A large part of the time of the committee has been spent in listening to irrelevant arguments by persons interested in some project in opposition to existing telegraph companies, or who had inventions to advertise. The principal result of this course has been the accumulation of a great mass of statements and statistics which no member of the committee has ever read, and which would afford little light on the subject if they were examined. What is needed is a deliberate, systematic and thorough investigation of the subject by an independent government commissioner, or some other competent authority. The information which could be obtained in this manner would be of incalculable value to the government and to all parties who desire a fair settlement of the question. It would settle many disputes that have vexed the country for years and prevent these periodical squabbles which accomplish no good purpose.

The present force is not equal to the task. The whole scheme rests on the mistaken idea that the present force of postal employés can do all the work of handling the telegrams in addition to their present duties and without increasing the expenses of the department. It will require much "persuasiveness" on the part of the postmaster-general to convince his subordinate officers of the correctness of this idea. It is safe to say that every one of these officers, in charge of bureaus which would be required to manage the various branches of the telegraph business, will admit that he could not take the first step without the expenditure of considerable sums of money, and there can be no doubt that enormous appropriations would soon be called for to carry it on.

Under the "limited" *regimé*, the business would be divided into two classes—telegrams and "slow telegrams"—and the assumption is that the enterprising American citizen, whom the post office department cannot satisfy with the swiftest mails that all the facilities of the nineteenth century can provide, will ask for nothing more than the privilege of dropping his telegram into a box without the slightest idea when it will reach its destination. This move is not in the right direction. The people want quicker, not slower, service. The march of American civilization is forward, not backward, and the electric telegraph is not the rear guard in the army of progress.

There are now about 600 free delivery offices, and the natural growth of the postal service would, possibly, increase the number to 2,000 in the course of five years. If the cheap telegraph service which the bill contemplates should be confined to this number of offices, and the service should be made efficient and valuable, the result would be simply the levying of a heavy special tax on the residents of the rural districts, for the next five or 10 years, for the benefit of a few commercial centers. It cannot be doubted, however, that the evident injustice of such an arrangement would bring forth from thousands of cities and towns a demand for equal government facilities, perquisites and appointments that no representative in Congress or official of the government could ignore or refuse, and the free delivery service of the post office department would necessarily be extended beyond all calculation, and the appropriations for its maintenance be increased beyond the most extravagant notions of the surplus reducers. One trifling point relating to the delivery service is worth noting in this connection. The department is about to have letter-boxes placed on the door of every house where letters are to be delivered, and, under the new system, this arrangement would much increase the slowness of the "slow telegrams."

The proposition to make telegraph operators of postmasters is too absurd to deserve attention. The department might as well try to educate locomotive engineers to run its fast-flying mail trains by giving its clerks a few months' practice in its passenger elevators. When the government goes into the business of operating telegraphs, railroads, electric light works and other industries requiring technical education and practical training, the closer it follows the methods that have been proven and established by long experience, the shorter will be its road to success. G. C. M.

Washington, D. C., Dec. 18.

FINANCIAL.

Closing quotations of electric stocks, from F. Z. Maguire & Co., Electrical Securities, 18 Wall street, N. Y., Saturday, December 20, 1890. New York, Boston and Washington Stock Exchanges. Pittsburgh closing December 19, 1890.

NEW YORK.	
Western Union Telegraph Co.	75.
American Telegraph & Cable.	33.
Central and South American	
Mexican	
Commercial Cable Co.	
Postal Telegraph Cable	39.
Edison General Electric Co.	84.
" " " Deferred	
Consolidated Electric Light	
Edison Electric Illuminating Co.	70.
United States Electric Light	30.
North American Phonograph	
BOSTON.	
Thomson-Houston Electric Co.	42.
" " " Preferred	98.
" " " Series C.	
" " " Series D.	53½.
" " International Co.	
" Welding Co.	
" European Welding Co.	
Ft. Wayne Electric Co	11.
TELEPHONES:	
American Bell	211.
Erie	46.
New England	48½.
Mexican	.70
Tropical American	
MISCELLANEOUS:	
Edison Phonograph Doll	
WASHINGTON.	
Pennsylvania Telephone	25.
Chesapeake and Potomac	
American Graphophone	11.
United States Electric Light (Washington)	135.
Eckington and Soldiers' Home Electric Ry.	52.
Georgetown and Tennallytown	45.
PITTSBURGH.	
Westinghouse Electric Mfg. Co.	19¾.

Telephonic News

*** The Bell Telephone Company are putting up new poles in Kingston, Ontario.

*** Arrangements are being made to secure a first-class telephone system for Thomasville, Ga.

*** The new telephone extension of the Selma and Camden, Ga., line has been completed to Alberta, a distance of 30 miles. The line will be further extended to Saffords and then Martin Station, which will complete a circuit of over 150 miles.

*** A group of French and Belgian capitalists is offering to undertake the construction of a telephone trunk line between Berlin and Warsaw, a distance of about 360 miles. The estimated cost of the line is £360,000. The syndicate proposes to hand over the line after a certain number of years to the Russian government.

*** The "Ville de Ramanabo," which recently left Antwerp for the Congo, had on board the wires, etc., necessary for the installation of the first telephone to be erected along the Congo Railway. The wire is of phosphor bronze, and the apparatus is of the type adopted by the administration of the Belgian Telegraphs for their private and service lines.

*** An account of an interesting balloon experiment is told by a traveler who has recently returned from Thorn, Prussia. The balloon was 15 by 13 metres, and required 1,000 cubic metres of gas to fill it. The car was connected by telephone with a near-by fortress. The apparatus worked splendidly both ways, and the voice of the commandant of the garrison could be distinctly heard at a height of 600 metres.

Future Generations Must Watch the Cylinders.

A. D. 2,000.—"Did you go to hear the phonographic parson this morning?" "Yes; but they got in the wrong cylinder and we had Rienzi's Address to the Romans instead of a sermon."—*N. Y. Herald.*

Honors to Sir William Thomson.

The REVIEW most cordially endorses the following sentiment expressed by our esteemed contemporary, the London *Electrical Engineer:*

"All the world knows that the new president of the Royal Society is Sir William Thomson, who succeeds Sir G. G. Stokes. This election will give universal satisfaction to all electricians who speak the English language, for a man more renowned both for practical work and scientific research cannot be named in this or any other tongue. The presidentship of the Royal Society is the very highest honor that can be bestowed upon English scientific men by English scientific bodies, and Sir William Thomson is a worthy recipient of it."

A Jury of One.

Judge Lacombe and a struck jury of one man were trying in the United States Circuit Court last week a suit brought in 1888 by the United States against the Union Pacific Railroad and the Western Union Telegraph Company, to recover $12,495.62 paid to the latter company for telegraph tolls. The facts are agreed on, and the jury will be instructed by the court what verdict the law requires of it. The act of Congress under which the Central Pacific road was organized, provided that the government should be entitled to retain all fixed charges for governmental telegraphic despatches, and apply the same to the payment of the bonded indebtedness of the road, and that of all the earnings of the road, both for the transmission of freight and passengers and of telegraphic messages, should be paid into the United States Treasury.

The telegraph lines formerly operated by the Union Pacific roads, were surrendered to the Western Union by an agreement entered into in 1881, since which time the government has had to pay for all its telegraphic messages. The further claim is made that by this surrender of the telegraph system of the road, five per cent. of the earnings of the Union Pacific, to which the government is entitled, is diminished.

INDUCTANCE AND ITS PROPOSED UNIT THE HENRY.

(*Continued from page 212.*)

is based upon a formula first given by Clerk Maxwell.* It is to be hoped that experimental evidence may shortly be collected corroborating these results.

The inductance of iron wires, in the absence of measurements, is almost too doubtful to justify calculation, being perhaps 10 times more than the inductance of copper wires under similar conditions. The difficulty in their case lies in assigning the proper value of permeability.

ELECTRIC LIGHT AND POWER.

Dynamos and dynamo-electric machinery are, of course, generally characterized by large inductances.

The inductance of the field magnets of a dynamo may have any value, depending on the size and voltage of the machine, from one henry up to 900 henrys.

The inductance of an armature may similarly vary from 20 millihenrys up to 50 henrys between brushes. One millihenry is a fair average value of the inductance of one section of an armature. Armature inductances depend not only on the strength of the measuring current, but also upon the strength of the field and whatever influences the permeability of the core.

The inductance of an alternating transformer varies from a primary of 400 millihenrys, a secondary of one millihenry and mutually 20 millihenrys with a transformation ratio of 20, up to corresponding values perhaps 100 times as great.

APPARATUS.—THE INDUCTANCE OF RUHMKORFF COILS.

The smallest medical coil in ordinary use has five millihenrys in its primary, 100 millihenrys in its secondary, and 20 millihenrys mutually between them.

A large induction coil, 19 inches long and eight inches in diameter, has 0.145 ohms and 13 millihenrys in its primary, 30,600 ohms and 2,000 henrys (by two concordant methods of measurement) in its secondary, and 168 henrys mutually between them.

The inductance of a mirror galvanometer may vary from a few millihenrys up to 10 or more henrys according to its resistance. Two henrys is a fair average for an astatic mirror galvanometer of 5,000 ohms.

An ordinary electric bell of 2.5 ohms resistance was found to have an inductance of 12 millihenrys.

There is one point in connection with the self and mutual inductance of induction coils and transformers that deserves attention owing to the confusion that occasionally arises concerning it. It may be, perhaps, best represented by a numerical example. Let a closed Faraday ring of iron 100 centimetres in mean circumference and 20 square centimetres in uniform cross section, be closely wound with a primary coil of 2,500 turns in one layer, followed by a secondary coil of 7,500 turns also in one layer. If now two amperes be maintained steadily through the primary, the magnetic force in the iron will be $4\pi/10$ times the ampere turns per centimetre of the iron circuit or $4\pi/10\times2\times2{,}500 \div 100$, or 62.85. The permeability of wrought iron at this force being, say, 250, the induction developed per square centimetre will be 250×62.85, or 15,713 lines, and the total induction enclosed by the primary coil, neglecting the space occupied by the wire itself, will be $20\times15{,}713$, or 314,250 lines which traverse every turn of both windings. The linkages with the primary will be $2{,}500\times314{,}250$, or in round numbers 786,000,000 and referred to one absolute unit of current (10 amperes), five times this number, or an inductance of 3,930,000,000 centimetres, that is, 3.93 henrys. Similarly the linkages of these lines with the secondary will be 2,358,000,000, and for ten amperes of primary current 11,790,000,000 of centimetres mutual inductance, or 11.79 henrys. Next, suppose the primary current interrupted, and a current steadily established in the secondary sufficent to produce the same magnetic force in the iron, thus avoiding the complication of a changing permeability. As the secondary has three times as many turns, the current effecting this will be two-thirds of one ampere. The total induction through the iron will now be the same as before and, therefore, the linkages will be equally numerous. The self inductance of the secondary will be $2{,}358{,}000{,}000 \div \frac{2}{3}$, or 35,370,000,000 centimetres, that is, 35.37 henrys. The mutual inductance will similarly be 786,000,000 $\div \frac{2}{3}$, or 11.79 henrys, as before. It will be found on carrying the reckoning to the necessary degree of accuracy, that this mutual induction 11.79 is the square root of the product of the two self-inductances, 3.93×35.37.

Examination of the steps in this calculation will show that this proposition must hold for all closed magnetic circuits uniformly magnetized to the same degree when the space occupied by the windings is not taken into account. Under the opposite conditions of open, and especially of short iron cores, with large winding spaces, the condition usually fails, and the mutual inductance may be greater or less than the square root of the self-inductances multiplied together.

Another reason in favor of selecting 1,000,000,000 centimetres as the value of the practical unit or henry, is the desirability of having the time constant of an electro-magnetic circuit expressed directly in seconds by its practical units, as in the case of electrostatic circuits, rather than revert to a unit of inductance that would yield the time-constant in milliseconds or other fractional period of time. The time-constant of a simple electro-magnetic circuit, a circuit having inductance and resistance but negligibly small electrostatic capacity, is defined as the ratio of its inductance to its resistance, that is, of its henrys to its ohms. It is an important function, and its consideration presents some remarkable analogies between inductance and electrostatic capacity that it is interesting to trace.

Imagine an inductance coil C without iron to be supplied with a steady current from an electromotive force E of 50 volts. Let the inductance of the coil be three henrys, and its resistance 10 ohms. (Fig. 2.) Ohm's law determines the strength of the current to be five amperes. Now short circuit the terminals of the coil very suddenly by a wire across its terminals of negligible resistance. The current in the coil C does not stop instantly, but under the name of extra current is maintained in the coil by reason of its inductance. According to theory, the last dregs of the current will never entirely vanish from the coil, although after the first few seconds the remainder is exceedingly small. The very first instant after short circuiting, the current continues at five amperes by its electro-magnetic momentum, but being unsupported, its energy is lost thermally in overcoming the coil's resistance, and it immediately falls. In falling, the lines of force linked with the circuit and sustained by the current, are drawn in, cutting the coil as they recede, thus creating a counter E.M.F., tending to prolong the current, and this process of dwindling current with reduction of opposition from the reserve of inductance, descend together. The total quantity of electricity that will flow through the circuit under the conditions specified, may fairly be called the charge or discharge of the coil, and it can be readily proved that this charge is equal to the quantity that would be conveyed by the initial discharging current, acting uniformly during a time equal to the time-constant of the circuit. In this case, the discharge commenced at five amperes, and the time-constant is 0.3 second, so that the total discharge will be that due to the flow of this current in 0.3 second, that is 1.5 coulomb.

To represent the case graphically, suppose the curve of discharge in time to be plotted as in the figure. Let the axis ox be divided off into seconds, and the axis oy into amperes. (Fig. 3.) The discharge commences at five amperes, subsides rapidly at first, but at last so slowly that an indefinitely long time must elapse before it altogether disappears. The area enclosed between the curve and the axes represents ampere-seconds or coulombs to the amount of the total charge, and the proposition just stated asserts that if the current had continued at five amperes steadily for 0.3 second, the area of the dotted rectangle so generated YDTO would be equal to the total area enclosed between the curves and the axes prolonged to the ultimate point of union.

Curiously enough, exactly the same law applies to the discharge of a condenser through a circuit of resistance but negligibly small inductance. The time-constant of the circuit, in this case, however, being its capacity in farads multiplied by its resistance in ohms.

The curve of discharge is of the same type for inductances or capacities. It is logarithmic, and finds its prototype in the case of the discharge of water in time, from a tank having a faucet at the base, assuming that the rate of escape through the faucet at any moment is directly proportional to the pressure or level of water then remaining in the tank.

The laws which control the outline of this discharge curve are identical for condensers or short-circuited inductances, and are combined in the following enunciation:

The natural logarithm of the ratio of the $\left\{\begin{matrix}\text{full charge}\\\text{initial current}\end{matrix}\right\}$ to the $\left\{\begin{matrix}\text{residual charge}\\\text{disch'ng current}\end{matrix}\right\}$ at any instant is the quotient of the time during which discharge has been in progress by the time constant of the circuit.

In this statement two reservations are necessary.

The electrostatic circuit must be free from all appreciable inductance, and the electro-magnetic circuit must contain negligibly small electrostatic capacity. It was first pointed out by Sir William Thomson that the discharge of a condenser through an inductance circuit becomes oscillatory when the inductance exceeds a certain critical value.

When an inductance discharges through a break instead of a closed circuit, the conditions become complicated to a degree that eludes complete practical solution in the present state of knowledge.

At the period of natural discharge equal to the time-constant, an inductance or capacity charge or current will have fallen to 36.8 per cent. of its initial value.

Similar propositions relate to the charging currents and quantities. In the above instance, after the coil has completely discharged, remove the short circuiting wire. The current will immediately enter the coil, and the curve of its arrival in time is represented in Fig. 4, this curve being only an inversion of the preceding. For this reason it is evident that the area above the curve now represents the charge, and by an extension of meaning, the deficit from full current, such as BC, may be called the charging current, since on discharge and reversal of the diagram, this will be the discharging current at the same lapse of time. In fact, the current AC is doing work in heating the coil, the deficit from ultimate current BC being only active in increasing the electro-magnetic momentum of the circuit, and work is really stored in the coil as though the deficit current did exist. A similar but inverted curve of current in time represents the charge of a condenser. In each case, and under the above restrictions, the following propositions hold:

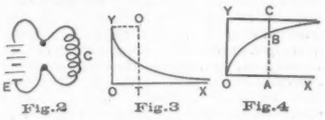


Fig. 2 Fig. 3 Fig. 4

The natural logarithm of the ratio of the $\left\{\begin{matrix}\text{full charge}\\\text{initial current}\end{matrix}\right\}$ to the $\left\{\begin{matrix}\text{deficit from full}\\\text{charging current}\end{matrix}\right\}$ at any instant is the quotient of the time during which the charge has been in progress by the time constant of the circuit.

When the charging interval reaches the time-constant, the charge will have attained 63.2 per cent. of its full value.

Another relation between simple electrostatic or electro-magnetic circuits and their time-constants is in their stores of energy. The energy of the charge in each case is half the energy that would be developed by the initial charging or discharging current against the ohmic resistance of the circuit in the time equal to the time-constant. In the above instance, for example, five amperes being the initial charging or discharging current, and the resistance 10 ohms, the circuit energy of this current per second would be $5\times5\times10=250$ joules, and during half the time-constant the energy thus developed would amount to $0.3\times250\div2$ or 37.5 joules. This is the electro-magnetic energy stored up in the charge.

These are not the only analogies that exist between inductance and capacity, but there are remarkable points of diversity. The discharge of extra current of a coil is in the same direction as the circuit current; with the condenser it is the reverse. In a great many practical instances, the electro-magnet and the condenser are used to annul each other's influence.

The time-constant of an inductance circuit is generally small, for the reason that a coil of large inductance has generally many turns and, therefore, high resistance, so that the ultimate ratio of the henrys to the ohms is not large. For example, the time-constant of a Bell telephone, considered in itself or on short circuit, is, from the measurement above described, about $0.09\div75$, or 0.0012 second, and, therefore, a steady E. M. F. of, say, two volts, impressed directly upon such a telephone would produce in this interval of time 63.2 per cent. of 2/75 amperes, namely, 169 milliamperes. By adding inductanceless resistance to the circuit, however, and raising the E. M. F. proportionately, the time-constant would be lessened and the arrival of current accelerated. Strictly speaking, this reasoning is inaccurate, since the telephone coil surrounds iron, but with the small currents usually employed, the iron probably does not greatly influence the arrival curve. In the case of dynamo field-magnets, and large iron-clad inductances generally, the divergence of the arrival curve from that of a corresponding simple electro-magnetic circuit is considerable.

There are several methods by which self and mutual inductance can be measured, the selection depending on the magnitude to be determined and its nature. The Ayrton and Perry secohmmeter or double revolving commutator is, perhaps, the most generally useful. It may be employed in connection with a standard condenser, a standard inductance, or apparent change of resistance with speed. Being used in the Wheatstone bridge, the currents it can alternate are necessarily limited in strength.

For small inductances,* say less than one-tenth of a millihenry, the method of Professor Hughes† or its modification by Lord Rayleigh, is probably best suited,

* Clerk Maxwell, "Electricity and Magnetism," second edition, vol. 1. p. 293.

**Journal of Institution of Electrical Engineers*, London, January, 1886.

†For another method of measuring small inductances with an alternating current, see an article by C. Steinmetz in the *Electrical Engineer*, vol. 10, Nos. 130, 131, November, 1890.

using two coils of mutual inductance and a telephone as the observing instrument.

The inductance coils are usually in the form of two concentric rings, the inner being capable of rotation about the common vertical. The mutual inductance of such a pair of coils is a complex function of the dimensions and the angle between the planes at which the coils may be set. It is usual to calibrate the instrument by separate measurements of the inductance at different angles. A simpler arrangement, however, for mutual inductance is a short solenoid in the bridge circuit superposed coaxially upon a long solenoid in the battery circuit. Adjustment to silence in the telephone for interrupted currents is then made by including in the bridge circuit a greater or less number of turns in the outer solenoid. The mutual inductance is then very nearly proportional to the number of turns so included, and by suitable proportions in construction, the accuracy can be carried as far as the telephone for the receiver will permit.

For the measurement of inductance in coils on iron machinery the ballistic galvanometer is frequently employed, either by the method of discharge for self-inductances or induced quantity with mutual inductances. Mutual inductances connected by closed iron circuits present no difficulty when great accuracy is not required, since, as already observed, the self-inductances are calculable in these cases when the mutual inductance and the number of turns in the coils are known. It is much more difficult, however, to measure the self-inductance of the field magnet of a dynamo when the armature is removed, and when currents of the normal exciting strength are used in the measurement. The best attempt has been made apparently by observing the discharge effects of gradual small changes of a strong current passing through the coil, in circuit with a specially arranged Wheatstone bridge.* If it were of sufficient practical importance, however, to measure such inductances with powerful currents, a recording instrument might be tried, having a very light and swiftly moving pointer, leaving a trace of its motion on a strip of moving paper, like Sir William Thomson's siphon recorder. If such a pointer were arranged to give an amplitude of movement at right angles to the paper strip, in proportion to the current traversing the coil, it would register the curve of discharge when the coil was short-circuited, in the manner described above. On a sufficiently enlarged scale, corrected, perhaps, for residual inertia in the moving parts, this curve would give not only the total quantity of discharge, but its deviation from the logarithmic line of simple electromagnetic discharge would give the means of determining the characteristic of magnetization in the iron.

Of far lesser importance than the selection of the practical inductance unit, but still well worthy of separate consideration, is the selection of appropriate symbols to represent the unit briefly. It might, perhaps, be advantageous to represent the henry by a capital H and the millihenrys by the plain letter h. This notation would enable such an inductance as 50 henrys to be written as 50 H, and 50 millihenrys as 50 h. The microhenry occurs so seldom that it would probably not need a symbol.

All measurements of precision should employ true ohms and not legal ohms in the computations. The best existing value of the true ohm is 1.0028 legal ohms.†

The correction is practically so small that it can best be carried out by altering the nominal standard temperature of the resistance coils adopted. These temperatures should be increased by 9.4°C. for platinum silver, 6.5°C. for German silver, and 13.5°C. for platinoid. Thus a resistance box with platinum coils standardized for legal ohms (of 106.0 cms.) at 15°C. would give true ohms of 106.3 cms. at 24.4°C. as the best approximation, and this would be the standard temperature of the box for use in precise measurements of inductance.

* *Philosophical Magazine*, Feb., 1869. Dr. Sumpner.

†Report of the Committee on Electrical Standards, read before the British Association, September, 1890. See the London *Electrician* of Sept. 26th, 1890.

The Electric City.

South Lakewood Park, N. J., Dr. J. B. de Lery's electric city, received very handsome endorsements from the New York *Times* and *Tribune* in last Sunday's editions. Each paper devoted about a third of a column to the new city, which is progressing finely in the line of disposing of sites.

A Good December Start.

The Short Electric Railway Company, of Cleveland, O., have the following contracts for the first 10 days in December: Pittsburgh and Birmingham Traction Company, Pittsburgh, Pa.; Broadway and Newburgh Street Railway Company, Cleveland, O.; Jamestown Street Railway Company, Jamestown, N. Y.

Tests of Tempered Copper.

The following report of tests of the products of the Eureka Tempered Copper Company, of North East, Pa., was recently transmitted to the Franklin Institute by the Committee on Science and the Arts. It also appeared in the *Journal of the Franklin Institute:*

The sub-committee appointed to examine and report upon application No. 1,491, made by the Eureka Tempered Copper Company, of North East, Erie County, Pa., dated April 21, 1890, and supplemented by their letter of August 7, 1890, beg leave to report:

That in the applications, as above, the applicants claim to possess processes invented by Almer Thomas and Luzerne Merket, of North East, Pa., in the first place, for casting pure copper without alloys, so as to make castings sound and free from blowholes; and, in the second place, for hardening copper (after casting) without destroying its fibre or impairing its usefulness for electrical or other purposes. They also claim that no alloys were added to the copper, and that the chemical composition of the castings is substantially the same as that of the ingot copper from which it was made.

As the processes in question (not having been patented) have not been described to your committee, we have, of necessity, confined our examination to the products of the applicants.

This examination has been made in three ways:

(1) Chemical analyses have been made of both the untempered and the tempered copper.

(2) Physical tests have been made, including tensile, transverse, compression and torsion tests, of the untempered and of the tempered copper.

(3) Circulars have been sent to over 100 establishments in the United States and Canada, using tempered copper, asking for the results of their use of same, with any expression of opinion that they may see fit to give.

The results of these examinations have been made as follows:

(1) Chemical analysis.

Dr. F. A. Genth, of Philadelphia, reports two sets of analyses of these coppers, as follows:

	(1) Pig Copper. Per Cent.	(2) Edge Pieces. Per Cent.	(3) Castings. Per Cent.
Silver	0.096	0.053	0.095
Copper	99.890	99.961	99.914
Tin	trace	0.045	0.094
Lead	trace	trace	trace
Iron	0.056	0.069	0.056
	100.042	100.128	100.159

	(1) Not Tempered. Per Cent.	(2) Tempered. Per Cent.
Silver	0.026	0.025
Copper	99 930	99.981
Tin	none	none
Zinc	none	none
Iron	0.082	0.088
Aluminium	none	none
Arsenic	0.046	0.042
Phosphorus	0.017	0.018
	100.101	100.154

The last two analyses were made from the same bar, No. 1 not tempered being made from the bar as cast by the processes of the applicants, but untempered; and No. 2 tempered being made after that bar had been tempered. It should also be mentioned that these same bars were used in the tensile tests described later on.

The above chemical examination shows that the examples are commercially pure copper, and thus substantiates the statement made to that effect by the applicants.

The principal tests were made by Mr. Tinius Olsen, of Philadelphia.

The diagrams, as made by his machine, are annexed to this report. The results, in figures, are also given on these diagrams. It is interesting to note how the tempered copper compares with the untempered copper in the first place, and in the second place how our tests compare with tests of ordinary commercial copper. It will be observed that the difference between the tempered and untempered copper is not very great; although, speaking generally, the difference is in favor of the tempered samples.

As compared with such tests of ordinary commercial copper as the committee have been able to find, the difference is more marked. For example:

Untempered pieces broke at a strain per square inch of

	Pounds.
(1)	23,180
(2)	24,410
Mean	23,795

and the tempered pieces broke at a strain per square inch of

	Pounds.
(1)	25,800
(2)	27,860
Mean	26,830

It should be mentioned that there was a similar flaw in all of the above samples (due to piping from the shrinkage), which ran longitudinally on the edge of the pieces. Most of this faulty part had been removed when the samples were cut in two lengthwise (for the purpose of having one-half of the piece sent to the applicants to be tempered). But a sample perfectly free from this piping would probably have given results somewhat higher than the above.

RECORD OF TESTS OF TEMPERED AND UNTEMPERED COPPER, MADE FOR THE COMMITTEE ON SCIENCE AND THE ARTS, AT THE TESTING ROOMS OF TINIUS OLSEN & COMPANY, PHILADELPHIA.

Marked.	Size.	Area in Square Inches.	Broke at Lbs.	Strain per Square Inch in Lbs.	Limit of Elasticity in Lbs.	Limit of Elasticity per Square Inch in Lbs.	Elongation in Inches.	Elongation per cent. of Original Length.	Area of Reduced Section in Sq. in.	Reduction per cent. of Original Section.	Memoranda.
Tensile,	.858										
B Tempered	.752	.6452	16650	25800	7400	11460	.72	18.0	.4725	26.7	
	.851										
A Tempered	.753	.6408	17856	27860	7000	10920	.94	23.5	.4060	36.6	
	.853										
B Untempered	.755	.6440	14930	23180	6550	10170	.84	21.0	.4095	36.6	
	.86										
A Untempered	.755	.6493	15850	24410	6550	10080	.90	22.5	.420	35.7	
Compression,											
C Tempered	.935×.938 1" high	.8770	49150	56040	13000	14820	.28	28.0			
E Tempered	.938×.934 1.002" high	.8761	46500	53070	13400	14150	.269	26.8			
C Untempered	.935×.937 1.002" high	.8761	41310	47150	12000	13690	.275	27.4			
E Untempered	.935×.939 1" high	.8779	45300	51600	14000	15940	.276	27.6			
Transverse,											
D Tempered	.938 .941	.8826	Commenced permanent deflection at 820.			Deflect, 1" at a load of 1380 lbs.					Strain applied in center of specimen on supports 12" apart.
F Untempered	.94 .942	.8854	Commenced permanent deflection at 500.			Deflect, 1" at a load of 1200 lbs.					
Torsion,											
C Tempered	.937	.6895	Yielded permanently at 120 lbs. Maximum load, 588 lbs. Ruptured after being twisted, 391°.								Measuring heads 2" apart and strain recorded on 12" leverage.
E Untempered	.937	.6895	Yielde i permanently at 106 lbs. Maximum load, 557 lbs. Ruptured after being twisted, 600°.								

To compare the above figures with those of ordinary commercial copper, we submit herewith the results made on cast copper, by the United States Testing Board, and given in their report on *iron, steel and other metals.* (Washington: Government Printing Office, 1878.)

Marks.	Greatest Stress per sq. in.
1A	14,180
1B	11,340
30A	29,200
30B	26,400
51A	14,546
51B	20,440
52A	16,940
52B	21,600
53A	18,800
53B	9,200
57A	26,000
57B	29,820
Mean	19,872 pounds per sq. in.

It thus appears that the untempered and the tempered copper have 20 per cent. and 35 per cent. greater tensile strength, respectively, than the average, as shown by the government report.

In regard to the compression, results (see diagrams herewith) are:

	Limit of Elasticity in Pounds.
Untempered (1)	12,000
(2)	14,000
Mean	13,000
Tempered (1)	13,000
(2)	12,400
Mean	12,700

The elastic limit of ordinary copper, according to Unwin (*Machine Designing*, D. Appleton & Co., 1877, p. 24), is 3,900 pounds, showing a great difference in favor of the samples tested by us.

As no figures for commercial copper, showing its tension and transverse strength, are available to the committee, we have been unable to make any comparisons showing the relative figures in these respects.

The result of the correspondence between the committee and various manufacturers, electric light companies, millwrights and other establishments, has been as follows:

In all, 53 letters were received in which a definite opinion was expressed. Of these, five were to the effect that the writer was unable to see any difference between the tempered copper and other metals and alloys. Eight parties had tried the copper, experimentally, for certain purposes, for which it evidently was unfit, such as for bits for rock-drilling; as a substitute for tempered steel; for ammonia pump rods; for cauterization of blemishes in the limbs of horses; for nozzles for locomotive injectors when using certain saline waters, and so on.

Six expressed the opinion that the claims of the applicants were not substantiated by the experience of the writers.

Thirty-four expressed opinions, based upon their experiences, which were highly favorable to the tempered copper. Thus, it was stated that for bearings on coal-mining machinery it lasts much longer than any other metal before used; that it outlasts from three to four times the old style of commutator copper bars or brushes; very satisfactory for brasses on engine rods; bearings on dynamos run very cool and require but little lubrication; gives entire satisfaction on bearings of three threshing engines; in wrist-pin boxes and in cross head; as step in gauge lathe, between end of spindle and set-screw, is superior to hardened steel, brass, rawhide or wood, all of which were previously tried; very uniform in hardness, and remarkably free from blow holes; gave good results as a driving pinion in gear work; stood up well as armature bearing in street car motors (a trying test), in small bearings, where the brass bearings would not last over 60 days, the tempered copper has been nearly in a year, and is apparently in as good a condition as when first put in. Many other extracts could be given, particularly from parties endorsing the copper for commutator brushes and segments, to which it seems particularly well adapted.

A number of specimens of castings are presented with this report, showing high excellence in quality and uniformity. Mechanical examination bears out the statements of the applicants as to the purity of their metals.

We believe that the claims of the applicants are substantiated by the experience of the majority of the parties using their copper, and also by our own investigations. We are of the opinion that the Eureka Tempered Copper Company has made a decided step in advance in the preparation of copper for many industrial uses, and we recommend the award to Almer Thomas and Luzerne Merket of the John Scott Legacy Medal and Premium.

TELEGRAPHIC

.... Under the name of "musical telegraphy," Dr. G. P. Hachenberg, of Austin, Texas, has offered his system for producing piano music electrically to the World's Columbian Exposition.

.... At a recent meeting of the regents of the California State University, Regent Phelps presented a report from the committee on the Lick Observatory, asking that the board should confirm a contract with the Western Union Telegraph Company, under which the company agrees to take charge of the lines running from San Jose to the observatory. The company will put the lines in repair and furnish messages at half rate, the regents to supply their own operator, until the messages equal 10 a day for six months. Then the company will put an operator in the station. After discussing the subject of the regents' responsibility for mistakes in messages under the contract, the matter was postponed until the next meeting.

* * The Mayor of Syracuse, N. Y., has vetoed another electric railroad franchise.

* * The Clinton Street Railway Company contemplates using the Edco storage system.

* * Columbus, Ohio, is to have a large number of its street railway lines equipped with electric power by the Thomson-Houston Electric Company.

* * The recent vote of the West End Street Railway directors of Boston, was to ask the Massachusetts railroad commissioners for right to issue $4,500,000 common stock. and to call a meeting of stockholders the latter part of the month to ratify this action.

* * A new company with a capital stock of $150,000 is being organized, it is said, to manufacture the Shaw electric traveling crane and other heavy electrical machinery. The plant will be established at some convenient point near Milwaukee, Wis., and will employ at the start 100 men.

* * The Lynn, Mass., Belt Line Street Railway Company, after a thorough trial of the Burton electric heaters, have equipped their entire line of eight cars with them. They say, in ordering the heaters: "We think them preferable to any other method of heating cars we have yet seen."

* * Several accidents have occurred because of the center pole construction of the Newark, N. J., Electric Railway. People stepping off the wrong side of the car have come in contact with a pole and have been seriously hurt. The press of Newark has united in a demand for a change in construction.

* * The railway department of the Chicago office of the Thomson-Houston Electric Company reports the following statement in regard to the business done by them from January 1st to November 30th, 1890: Number of contracts, 54; number of generators, 74; number of motors, 647; horse-power of motors, 9,940; horse-power of generators, 6,130.

* * At a meeting of the board of directors of the University Park Electric Road, of Denver, Col., held last week, a proposition from the Tramway Company for the purchase of the road was considered and accepted. The consideration is said to be $32,000, payable in first mortgage bonds, one-half of which the Tramway Company will purchase for each. A single five cent fare for passengers to and from the business center of the city is one of the considerations of the transfer. The line is also to be extended to the center of University Park.

* * The Citizens' Traction Company, of Pittsburgh, Pa., a street car corporation which operates about seven miles of cable lines in that city, has decided to extend one branch of its line, from Butler street to Sharpsburg, for a distance of three miles. This extension will be operated by the electric overhead wire system. The contract for the equipment of the cars with motors has been awarded to the Westinghouse Company. As the power house will not be completed for some time yet, the road will not go into operation until the Spring.

* * St. Louis, Mo., has perhaps more electric railway lines in operation than any other one city in the United States. There are four separate and distinct lines in that city equipped with the Thomson-Houston railway system, in addition to which there is one line across the suspension bridge at that place, which is equipped with the same system, and a smaller line immediately across the river from St. Louis conecting with the bridge line, which is also equipped with the Thomson-Houston apparatus. The total number of cars equipped with the Thomson-Houston system in St. Louis is 139, the number of motors 278, the total horse-power of which is 4,170.

An Important Letter.

We have received the following self-explanatory letter from George R. Davis, the director-general of the World's Columbian Exposition:

To the Editor of Electrical Review:

Sir: I have the honor to enclose herewith copy of a circular letter which I have sent to all the manufacturers of electrical supplies and appliances, etc., in this country, whose addresses I have been able to obtain. The object of this circular, as you will see, is to ascertain as nearly as possible, at an early moment, the probable amount of space which will be required to accommodate exhibitors of this class.

The idea is to erect upon the Exposition grounds a special building entirely devoted to this class of exhibits, and it is hoped to make it one of the most useful and interesting features of the Exposition.

In drawing the plans for the building it is necessary to obtain, as far as practicable, an estimate of the space which will be required, and I have to request that you will bring this important matter to the attention of the readers of your valuable journal, and urge those who propose to exhibit to communicate at once with this office as to the probable amount of space they will require, whether they received one of the circulars or not. I am,

Very respectfully,
Geo. R. Davis,
Director-General.

Chicago, Ill., U. S. A., Dec. 18, 1890.

The circular letter referred to is as follows:

Gentlemen: For the purpose of ascertaining approximately the amount of space that will be required for the electrical exhibits, and as it is contemplated to erect a building to be used exclusively for this purpose, I have the honor to request the following information:

1st. Do you propose to make an exhibit?
2d. If so, the approximate amount of space you will require?
3d. The amount of steam, if any?

A reply to above questions will not be considered as an application for space, but an estimate on which to base calculations for building.

It is desirable that this information should be received within the next two weeks.

Very respectfully,
George R. Davis,
Director-General.

Chicago, Ill., U. S. A., Dec. 18, 1890.

* * The Sioux Falls, Dak., Electric Railway Company operates an electric circuit 14 miles long.

* * Holyoke, Mass., will very probably have electricity substituted for horse-power on its street car lines next Spring.

* * If any one wants a share in the Brockton and Whitman Electric Road it will cost him just about $125. At that figure it would be a better investment than Calumet and Hecla at $245.—*Brockton, Mass., Enterprise.*

* * The street railway systems of Cedar Rapids and Marion, Ia., have been sold to an Eastern syndicate. The new company will change the power from horses to electricity. The line from Cedar Rapids to Marion is included in the deal.

* * The Thomson-Houston Electric Company is reported to have sold out its interest in the Newport, R. I., Street Railway Company to a syndicate composed mostly of citizens of that city. It will be remembered that this road was strenuously objected to by the cottagers and many of the citizens, when first put in, and was threatened by law suits by some of the wealthier residents, who did everything in their power to hinder the company from operating in Newport.

* * One of the greatest business enterprises now under way in Maine is the plan of prominent business men of Kennebec and Knox Counties to build an electric railroad from Thomaston through Rockland to Camden. There is opposition to the road in Thomaston and Camden, especially in the latter place, and from all signs now the meeting in Camden is likely to be a lively one. Some of the Camden village people don't want the electric cars to run on their shore road, as they think it will spoil the road for Summer pleasure driving. The lime manufacturers of Thomaston are in favor of the road, as it could be utilized to land lime rock from the quarries into Thomaston. The streets that are now intended to be covered will require 20 to 25 miles of rail. Some 16,000 or 17,000 people will be accommodated.

The Bain Break Insulator.

This insulator is designed to take the place of the ordinary crude devices that have been used as break insulators. The new insulator is made of one piece of porcelain, carefully glazed, and is so simple as to require scarcely a word of explanation; while its great strength and perfect adaptability are sure to commend themselves to all

The Bain Break Insulator.

practical construction men. It will be found especially useful, also, for suspending arc lamps from iron cranes, insulating guy wires, and, particularly, for insulating span wires in electric railroad work. The Central Electric Company, of Chicago, control the patent and are placing the device upon the market.

* * The electric railroad at Atchison, Kan., carries school children for $1 a month.

* * At a meeting of the Brooklyn aldermen last week a letter from President Wm. Richardson was read, saying that on June 2 the Atlantic Avenue Railroad Company applied for permission to substitute electricity for horses upon its lines. No action has been taken, and President Richardson desired to renew the application, and if consent were granted the company would make the change with the least possible delay. Electric power of the most approved kind would be substituted. The matter was referred to the Committee on Railroads.

* * Advices from Burlington, Vt., under date of December 10, state: "An electric power enterprise has just been inaugurated in this section, having been organized under the name of the Vermont Electric Company. The charter secured by the incorporators is an unusual one, and met with great opposition in the State legislature. It has valuable privileges, under which the company will soon begin to operate. One of these is the development of the property known as the Gorge, near the twin railroad bridges, just above Winooski village, and the transmission, electrically, of this immense water-power to Burlington, to be used in driving all kinds of machinery. This is no experimental work. A new industry, on a broad and permanent foundation, has been inaugurated in the establishment of plants for the generating and transmission of power for general use and sale in all units, from an eighth horse-power upward, and for short or long distance transmission, from half a mile to 20 miles. It has been voted to increase the capital stock to $100,000.

ELECTRIC CLUBS.

New York Electric Club.

The Regular Monthly Meeting of this Club was held Thursday evening of last week, and a very instructive and timely lecture on "Electrical Units of the Present and Future," was delivered by Prof. Francis B. Crocker. Ex-President Henry C. Davis presided. The object of the lecture was to show the real meaning and way of determining the various electrical units, such as volt, ampere, ohm, etc., now in common use, but not very clearly understood by most electrical men. The naming of the new unit of self-induction after Prof. Joseph Henry (calling it a "henry") was also discussed. This name is likely to be generally adopted, and is specially interesting as being the first American name for an electrical unit, although England, France, Germany and Italy, have already been honored in this way. The lecturer also pointed out the necessity for one or two new magnetic units and proposed names and values for the same. We shall publish in full in our next issue.

At the Business Meeting of the Club, before the lecture, amendments to the By-laws were adopted, which change the classification of membership from "non-resident" and "resident" to "associate" and "active," and reduce the initiation fee of the former to $20, and annual dues to $20; the initiation fee of active members was reduced from $50 to $40, and annual dues to $40. The limit of membership was raised from 750 to 1,000. In the former By-laws a non-resident member had to reside 50 miles from New York. No such restrictions relating to associate members are in the amended By-laws. It is hoped that this change will increase the usefulness of the Electric Club and bring in a number of new members from the young as well as more advanced students of electricity.

Recent Out of Town visitors were: Patrick Walsh, editor of the Augusta, Ga., *Chronicle;* W. B. Sparks, Macon, Ga.; Frederic J. Cooke, Augusta, Ga.; Geo. W. Adams, Boston; R. E. Richardson, Chicago; Ferdinand A. Wyman, Boston; W. J. Best, Philadelphia.

American Institute of Electrical Engineers.

At the Regular Monthly Meeting of the council, held December 16, 12 associate members were elected, among them being Mr. P. H. Alexander and M. C. Sullivan. At the same meeting seven associate members were transferred to full membership, their applications having been approved by the Board of Examiners at its meeting held December 3d. Among these were Harold Binney, F. A. C. Perrine and Herbert Laws Webb.

Millis Electrical Society.

An Electrical Society has been formed at Millis, Mass., for the purpose of keeping pace with electrical improvements. The society has chosen: President, William Collins; vice-president, Fred. Daniels; secretary and treasurer, Tobias E. Steere.

Wisconsin Electric Club.

At a Meeting of the Wisconsin Electric Club, December 11th, a paper was read by Henry D. Goodwin on the improvement lately added to the Edison phonograph. The cutting needle and knife and the reproducing needle are now made of sapphire or diamond. A single diaphragm of glass is used, that being found the most satisfactory, although diaphragms of iron, steel, aluminium and other substances answer well. The phonograph has been greatly simplified, and is rendered very sensitive to delicate sounds by the new sapphire needles and the new cylinders. The machine is geared so that the cylinder will hold a long dictation. The members were much entertained at the close of the reading by renditions from Clauder's band—from the phonograph.

* * Paul W. Bossart, representing the Detroit Electrical Works, closed on Monday, the 15th inst., a contract for the equipment of the People's Electric Street Railway, of Springfield, Ill. The contract calls for 14 motors of 30 horse-power each with trucks; two 100 horse-power generators, and ten miles of overhead wire.

To the Inventors of America and the Manufacturers of Inventions.

The following circular letter has been issued by the Central Committee for the Celebration of the Beginning of the Second Century of the American Patent System:

The completion of the first century of the American patent system marks so important an epoch in the history of the nation that it is eminently proper that the beginning of the second shall not pass unnoticed.

The centennial anniversaries of other important national events have been celebrated in a manner worthy of a people proud of their country and its growth. Surely the system that has aided the agriculturalist in the field, the mechanic in the shop, and the toiler in the mine; that has stimulated invention and helped every branch of modern industry, has played no small part in a history so full of the triumphs of human achievement.

Believing that the American inventor and manufacturer of inventions will regard it a privilege, as well as a duty, to co-operate in making due recognition of these facts, it is proposed to hold a celebration at the national capital, in April next, which shall, in a fitting manner, commemorate the important event, and place on record the nation's appreciation of the labors of those whose ingenuity, patience and tireless effort have exercised such a potent influence in accelerating the prosperous growth of the nation and in aiding the progress of our civilization.

The necessity for a National Association of Inventors and Manufacturers of Inventions, organized for mutual benefit, has been frequently discussed in the technical and other journals.

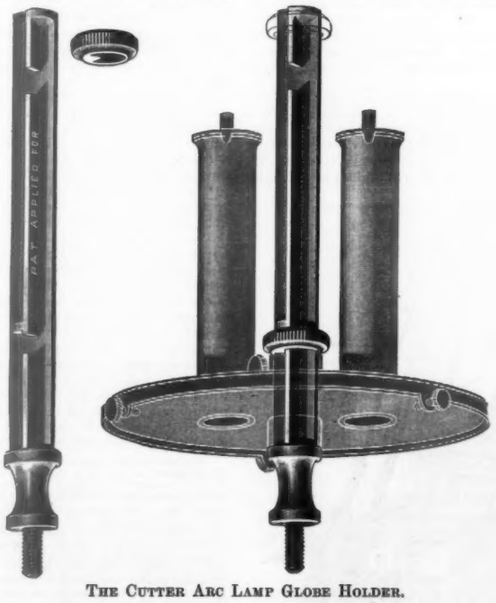
No time could be more opportune for the formation of such an association than when men from every part of country meet to celebrate so important an anniversary.

Surely the occasion is most inspiring.

All inventors and manufacturers, and others interested, are requested to co-operate with this committee in the purpose above set forth. Correspondence appertaining thereto, should be addressed to J. Elfreth Watkins, secretary, United States National Museum.

Improved Globe Holder for Arc Lamps.

Our illustrations show a new device, brought out by George Cutter, of Chicago, designed to facilitate the trimming of arc lamps. The globe holder is supported by a ring, which is knurled so that it can be readily turned with the fingers. The rod, which takes the place of the tube used in many lamps, has a star shaped section, and, as the cut shows, has a shell on which the ring rests when the globe is in position. On raising and turning the ring slightly, it drops



THE CUTTER ARC LAMP GLOBE HOLDER.

to the end of the rod, thus letting the holder and globe slide down out of the way. When the lamp is trimmed, the ring is raised to its former position and given a quarter turn when it again rests on the shelf shown, and safely supports the globe holder. To remove this entirely, the ring is slipped down until opposite the notch in the rod and given a quarter turn, when both the ring and the globe holder can be slipped off. The globe can then be replaced and the holder slipped back and clamped in place in an instant.

Both the rod and the ring are made of brass, and will fit any Thomson-Houston double carbon lamp. By their use the globe can be lowered, raised or removed altogether, in a few moments.

McCreary's Socket Protector.

The McCreary Electrical Specialty Company, 18 and 20 Cortlandt Street, New York, are the manufacturers of the moisture proof socket protector illustrated herewith. Referring to the cut, A is a metal cap containing a rubber gasket, B a metal shell covering all

MCCREARY'S MOISTURE PROOF SOCKET PROTECTOR.

kinds of sockets, and C a rubber neck covering the opening where the lamp is inserted. D is the lamp.

The makers claim that this device effectually protects the lamp against moisture at a merely nominal cost. It is especially adapted for use in marine installations, breweries, mines, stables, bath houses, basements and on street lights.

Electricity vs. Gas in Paris.

An exchange says that "The Paris Gas Company is said to be the first of the important European gas companies that shows a visible decline, distinctly due to the increase of electric lighting. The decreases for August and September of the present year, as compared with the same month last year, are, respectively, eight and six per cent."

—— All of the stock of the Chartiers Electric Light Company has been sold at par, and the building for the plant is being pushed as fast as possible. It is the purpose of the company to supply electricity to Chartiers, Mansfield, Crafton, Idlewood and Ingram, all Pennsylvania towns.

A New Idea that Seems to be Thirty Years Old.

TO THE EDITOR OF ELECTRICAL REVIEW:

In the REVIEW of December 13, 1890, page 194, under the head of "Electrical Power," I see the notice of the Edison Company, at Schenectady, N.Y., using a locomotive as a source of temporary power, with comments, saying this is the first time a locomotive was ever so utilized.

I write, believing it would interest you and your readers to know that James Long, in 1860, master mechanic for the Memphis and Ohio Railroad, used a locomotive as a stationary power for the temporary shops in the old armory building. He reversed the boxes, jacked the engine up, and belted from the drivers. Yours truly,

A. F. WINEMAN.

Austin, Ill., Dec. 17, 1890.

—— Kenosha, Fort Atkinson and Waterloo, three wide-awake little Wisconsin cities, will be lighted by electricity.

—— The people of Haverstraw, N. Y., are considering a proposition to bond the village for $20,000 for the establishment of an electric light plant.

—— The directors of the Consolidated Electric Light and Gas Companies in Annapolis, Md., have elected W. H. Bosley president and Theophilus Tunis secretary and treasurer.

—— Mansfield, Pa., is one of the latest towns in Western Pennsylvania to operate a central station plant of electric lighting. The Westinghouse alternating current system will be installed in the plant.

—— Electric light and power companies are being formed at a wonderful rate. Scarce a town with 5,000 inhabitants that has not one or more of these companies, and those that have not are stirring themselves to keep up with the procession.—*Manufacturers' Gazette.*

—— The Westinghouse Electric Manufacturing Company is now installing a central station electric lighting plant at Berlin, N. H., with the Westinghouse alternating current apparatus. The plant will commence operations with 750 sixteen candle-power lights capacity.

—— A special meeting of the stockholders of the Edison General Electric Company will be held January 19th, 1891, at the offices of the company, 42 Broad street, New York city, to vote upon a proposition to increase the capital stock of the company from $12,000,000 to $15,000,000.

—— The Hartford Electric Light Company has finished its new dam across the Farmington River at Tariffville, Conn. The company's buildings, on the river bank, to be used for generating power, are still in course of erection; but it is expected that these will be finished early in the Spring.

—— The electric light company at Rich Hill, Mo., employed a colored man to operate its plant. A committee of whites waited upon him and notified him that if he continued to hold the place it would be at the risk of his life. The negro became frightened and left the town, and now the company is without an engineer.

—— The town of Attleboro, has voted to establish an electric lighting plant of its own. This is another indication of the tendency towards municipal management of such enterprises. We judge, however, from the report of a town meeting which considered the subject, that the voters have really little idea of how much their speculation will cost.—*New Bedford, Mass., Mercury.*

—— The Albion Electric Company, of Albion, N. Y., where an electric light plant of 500 lights has been operated about a year, is now compelled to increase its capacity. The central station is operating the Westinghouse alternating current system, and the Westinghouse Electric and Manufacturing Company, of Pittsburgh, Pa., has received an order for its apparatus of 750 lights capacity, which will immediately be installed at the Albion plant.

ELECTRIC LIGHT NEWS

—— Some new sleeping cars recently built by the Wagner company cost $23,000 apiece. Each berth has an adjustable incandescent lamp.

—— It is reported that a cross illuminated with electricity will be placed on the spire of Grace Church, on Stockton and California streets, San Francisco.

—— For a consideration of $200,000, the Seattle Gas and Electric Light Company, represented by President Dexter Horton, last week transferred its stock to the Seattle Gas and Electric Light and Motor Company.

—— The stockholders of the Edison Illuminating Company, of Easton, Penn., have decided to increase the capital stock from $100,000 to $200,000. The increase is to be used in enlarging the plant to twice its present size.

—— Argument was concluded before Judge Truax, December 16th, in the proceedings to continue the temporary injunction restraining the New York Board of Electrical Control from entering into any contract for the construction of subways with the Empire City Company. Counsel will submit briefs this week.

—— The stockholders of the Pasadena, Cal., Electric Light and Power Company met last week, President Wood presiding. After considerable discussion, it was determined to increase the bonded indebtedness of the company from $20,000 to $25,000. It is likely the company will be awarded the contract for lighting the city.

—— The worst and most expensive thing in Carondelet is its gas. It is a shame that a place of its size should be treated in such a way in the matter of lighting. Carondelet should have electric lighting as well as the city. It certainly needs it as bad. Electric lighting extends to other points as far from the heart of the city as Carondelet is, and it seems to be a species of unjust discrimination against this end.—*St. Louis Sayings.*

—— The Aransas Pass Electric Light and Power Company, of Aransas Pass, Texas, which only a few months ago started up a plant of 500 alternating current incandescent lights, has already made the experience that electric light is what the people want and that they will have it. Hence the company has also added an arc light plant to its central station. The apparatus operated is of the alternating current system of the Westinghouse Company.

—— Little Falls has a village charter which allows the president to veto any proposition, and the trustees cannot pass it over the veto. This authority has just resulted in depriving the village of light by electric arc lamps until after another election. The trustees passed a resolution to raise $6,400 for 80 lamps. The president wanted $8,000 appropriated, and so vetoed the resolution. Thus the matter will stand, and no lights will be had.

—— The directors of the Mather Electric Company have decided to make application to the legislature, this Winter, for a charter under which they can organize a separate company for the purpose of lighting the streets of Manchester, Conn., furnishing electric power and, if deemed advisable, building and operating a tramway between Manchester and South Manchester. The incorporators of the new company are: N. T. Pulsifer, M. S. Chapman, H. G. Cheney and Robert Cheney.

—— The incandescent electric light is rapidly supplanting the gas lamps out West. The Keokuk Electric Light and Power Company, of Keokuk, Ia., after having established a central station electric lighting plant of the Westinghouse alternating current system last year, has just made another contract with the Westinghouse Electric and Manufacturing Company for the supply of two dynamos. With this addition, the Keokuk plant will have a capacity of 2,250 sixteen candle-power lamps.

A Notable Book on Electricity.

SOME OF THE FEATURES OF "ELECTRICITY IN DAILY LIFE," WRITTEN BY WELL-KNOWN EXPERTS.

There has recently been published in a handsome octavo volume the series of articles on electricity, which has appeared from time

DR. WERNER SIEMENS.

to time, throughout the past year, in *Scribner's Magazine*. We have occasionally reviewed these articles at the time of their appearance, but it is only in their collected form that one can fully realize the scope, thoroughness, and weight of authority which characterize them. The volume is entitled "Electricity in Daily Life.* A popular Account of the Application of Electricity to Every-Day Uses," and contains 125 illustrations made after the excellent manner of our modern magazines.

Before leaving this subject of illustration, we would call attention to the accuracy with which they have been made, as well as their artistic merit. In every case the pictures appear to be made either directly from a photograph of electrical appliances in operation, or from sketches made from the objects by competent artists. This gives the volume value as a record of the most approved electrical appliances as they existed in 1890. The illustrations are also notable by reason of the 14 excellent portraits of men eminent in electrical discovery and invention. Some of these are made from rare prints and they have been engraved most skillfully. We reproduce in this article one of them.

But the most notable thing about this book, and that which will attract the attention of practical electricians, is the eminence and distinction of the authors who have contributed the 10 chapters which make up the volume. Each subject is discussed by a man who is known to be thoroughly versed in all its details; therefore, although this volume is written in untechnical language for a popular audience, the facts and theories which it contains are of that importance and significance which make them valuable to the technical man as well. When Professor Cyrus F. Brackett writes of electrical measurement, Franklin L. Pope of the electric motor, President Morton of electric lighting, Charles L. Buckingham of the telegraph, even the most expert electrician is interested in knowing what they have to say and is assured that he is receiving an accurate statement of the most advanced electrical science. We shall point out a few of the interesting features in some of these articles in order that our readers may have a glimpse of the style and merits of this valuable book.

Professor Brackett's introductory chapter is a comprehensive statement of the common methods in accordance with which the more important electrical phenomena are produced, the laws which they reveal and the principles involved in the measurement of electrical quantities. This chapter is a model of scientific condensation, and puts the principles of practical electricity in a nutshell. As an illustration of Prof. Brackett's lucid statement of the application of a principle, we give his description of the elements of the *magneto-electric machine*.

"Having now a clear idea of some of the more remarkable effects which may be produced by means of the electrical current, we may with advantage consider some additional means of producing the current itself. We have just seen that a bar of iron, when placed within a helix, through the wire of which a current of electricity is flowing, becomes a powerful magnet. Experiment shows, conversely, that if the extremities of the wire constituting the helix be disjoined from the battery and brought in contact with each other, and if then a powerful magnet be thrust back and forth in the helix, a current of electricity will be set up which will continue to flow so long only as the motion of the magnet continues. If a bar magnet be carried, in the direction of its length, quite through the helix, the current which is induced in the helix by this motion will be reversed in direction when the mid-point of the magnet passes the mid-point of the length of the helix; and if the magnet be thrust only half-way through the helix and then withdrawn, the same result will be produced. It is plain, then, that we can set up an electromotive force in a conductor by merely moving a magnet with reference to the conductor, and that we can determine the direction in which the electromotive force shall act to produce its corresponding current of electricity by our choice of direction in which the movement shall be made. Moreover, it is quite a matter of indifference whether we move the magnet or the conductor, or both, so long as the two change their relation to one another, and experiment shows that the magnitude of the electromotive force, and consequently that of the electrical current, is also under our control. It depends upon the strength of the magnet, on the velocity and direction of its motion, and on the number of turns of wire in the helix.

THE MAGNETIC FIELD, AS INDICATED BY IRON FILINGS THROWN UPON A PANE OF GLASS RESTING UPON THE POLES OF AN ELECTRO MAGNET.

"We might easily devise a machine operated independently, such as the steam-engine, which would continually thrust a magnet into a helix and withdraw it, by a reciprocating motion. We should then have a means of producing currents of electricity which would depend upon mechanical power for the energy which must be supplied. For certain purposes the alternating character of the currents so produced would be a matter of no importance. It is not difficult, however, to devise means by which such a machine can automatically change the relations of the conductors, in which the currents flow outside of the helix, so that they shall flow always in the same direction. Any form of such apparatus is properly called a *magneto-electric machine*."

Franklin Leonard Pope follows with an historical summary of the development of the electric motor, from Faraday's experiment, on Christmas morning, 1821, when he first made an electric bar revolve about a wire through which a current was passing, to the successful application of electric motors to street railways. Mr. Pope's article contains rare illustrations of certain early forms of the electric motor, such as Barlow's spur-wheel motor and Professor Henry's and Sturgeon's electro-magnetic engines. It is interesting to know what so conservative a man as Mr. Pope has to say about the wonderful possibilities of the application of electricity in rapid transit. We give his concluding paragraph:

"It would be impossible, within the limited space at command, to attempt to enumerate the various future applications of the electric motor which suggest themselves to the enterprising electro-mechanician but, in conclusion, the writer cannot refrain from expressing his conviction that the day is not far distant when rapid transit between the principal cities of America will be effected to an extent which to persons unfamiliar with the developments of electricity must seem utterly visionary and chimerical. Once admit, as we must do, the possibility of applying almost limitless electric power to each axle of a train, with the possibility of laying a track almost as straight as the crow flies from city to city, rising and falling as the topography of the country may require, and the complete solution of the problem becomes little more than a matter of detail. Not that such detail is unimportant, nor that the innumerable minor difficulties can be overcome without much experiment and study; but it may nevertheless safely be affirmed that the ultimate result is already distinctly forshadowed, and that we may expect, within a few years, to be transported between New York and Boston in less than two hours, not by the enchanted carpet of the Arabian Nights, but by the potent agency of the modern electric motor."

Mr. Joseph Wetzler takes up the subject where Mr. Pope leaves it, and gives a summary of the exact condition of the commercial application of electric motors to street railways at the present day. What Mr. Wetzler has to say is founded on an accurate study of statistics and the results of railways in active operation, so that the investor and practical constructor of street railways will find in his chapter a great deal that is of value to him in his work. The author gives impartially a description of all systems—overhead, underground and storage battery. He also has something to say of the experiments now in progress for high speed transportation, such as the Weems' and Port electric systems.

President Henry Morton's chapter on electricity in lighting is valuable in two directions; first, as a succinct historical summary of the development of the electric light, from Sir. Humphrey Davy's experiment, in 1808, when he exhibited an arc light on a grand scale with a galvanic battery of 2,000 pairs of plates, down to the successful solving of the problem of placing these arc lights in series by the modern inventor, Mr. Brush. An equally valuable historical summary is given of the development of the incandescent light, from Starr-King's platinum lamp of 1845 to the present carbon filament which is in daily use. In the second place, President Morton is successful in giving a clear picture of the actual making of a dynamo machine, from the winding of the armature to the final placing of the magnets in their frame. Every stage in Professor Morton's exposition is illustrated with a picture from some old or modern motor.

"The Telegraph of To-day" is very appropriately treated by Charles L. Buckingham, the patent attorney of the Western Union, who has for many years made an exhaustive study of the whole subject and is fitted, both by scientific knowledge and legal training, to discuss the subject dispassionately. Mr. Buckingham gives very little space to an historical review, but devotes his energies to explaining the telegraph in actual commercial operation over 600,000 miles of wire and transmitting 50,000,000 messages annually, in the United States. It is this great system which is so entirely different from anything Morse conceived that interests modern readers. The author has made plain how such a tremendous commercial enterprise is possible. His explanation of duplex, diplex and quadruplex methods will surely for the first time enable many a reader (who has been perplexed with scientific terminology) to understand the intricacies of these ingenious systems.

WINDING AN ARMATURE.

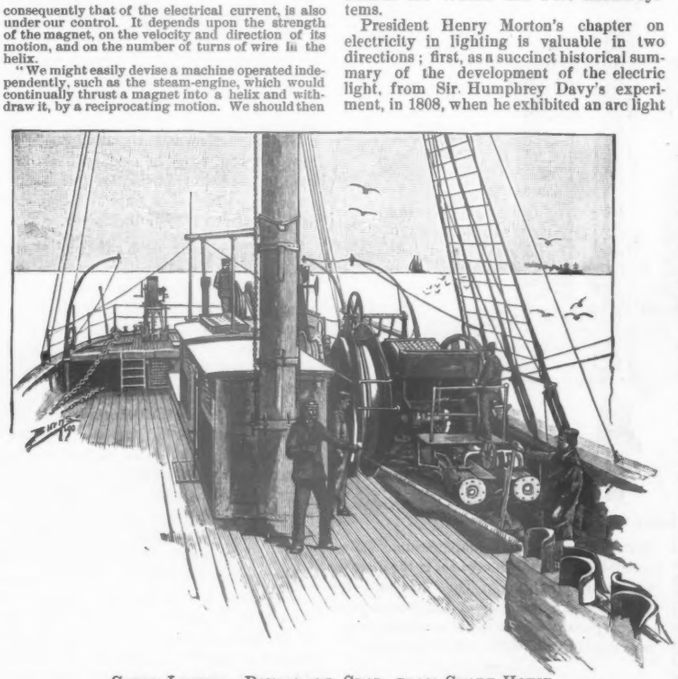
Mr. Buckingham's explanations of submarine telegraphing, type printing telegraphs and telegraphing from a moving train, are equally interesting. The pictures which adorn his chapter are among the most important and effective in the book.

"The Making and Laying of a Cable" very naturally follows Mr. Buckingham's article, and the author is Herbert Laws Webb, the member of a family prominent in electrical affairs in Great Britain and a young man who has had abundant experience in the actual work of cable ships. His chapter takes the form of the description of a typical voyage and abounds in bright pictures of the life on board a cable ship. Though in narrative form, the chapter is just as valuable as though stated in the dry formulæ of the text book. We reproduce two of the illustrations from Mr. Webb's article—the paying-out gear and the landing of the shore end of the cable. We also give his excellent summary of the cable mileage of the world.

"In these days of rapid development in new fields of electrical science and their commercial application, it is easy to overlook the magnitude of the work accomplished in the laying of deep sea cables. According to the latest report of the International Bureau of Telegraph Administrations, the submarine telegraph system of the world consists of 120,070 nautical miles of cable. Government administrations own 12,524 miles, while 107,546 are the property of private companies. The total cost of these cables is in the neighborhood of $200,000,000. The largest owner of submarine cables is the Eastern Telegraph Company, whose system covers the ground from England to India, and comprises 21,860 miles of cable. The Eastern Extension, which exploits the far East, has 12,958 miles more. Early in last year the system of West African cables, which started from Cadiz only six years ago, was completed to Cape Town, so that the dark continent is now completely encircled by submarine telegraph, touching at numerous points along the coast. More than 17,000 miles of cable have been required to do this, and several companies, with more or less aid from the British, French, Spanish and Portuguese governments, have participated in carrying out the work.

"The North Atlantic is crossed by no less than 11 cables, all laid since 1870, though I think not all are working at the present time; five companies are engaged in forwarding telegrams between North America and Europe, and the total length of the cables owned by them, including coast connections, is over 30,000 nautical miles.

"The cable fleet of the world numbers 37 vessels, of an aggregate gross tonnage of about 54,600 tons. Ten ships belong to the construction companies,



CABLE LAYING.—PAYING-OUT GEAR, FROM CHART HOUSE.

*ELECTRICITY IN DAILY LIFE.—A popular account of the science and application of electricity to every-day uses. With 120 illustrations. 8vo., $3.00. Charles Scribner's Sons, Publishers.—Address ELECTRICAL REVIEW, 13 Park Row, N. Y.

their aggregate gross tonnage being about half that of the entire fleet; the other 27 are repairing steamers belonging to the different government and telegraph companies; they are stationed in ports all over the world, keeping a watchful eye on the condition of its submarine nerves, and doctoring them up whenever they need attention."

The applications of electricity to warfare are attracting the attention of all progressive governments, and many thousands of dollars are appropriated at the present time for experiments in this direction. Lieut. W. S. Hughes, U. S. N., who has had much to do with these experiments in the United States navy, writes the chapter on "Electricity in Naval Warfare," and gives the most advanced experiments and achievements in this line. He treats of electric signaling, illumination of gun sites, torpedo detectors, electric logs, propellers for fish torpedoes, electric range finders, steering gear, and, perhaps, the most important of all, the search-light, of which we reproduce an excellent picture.

In a similar manner, Lieut. John Millis, of the Corps of Engineers, U. S. A., who was recently sent to France to study the subject, treats of "Electricity in Land Warfare," discussing the question of the determination of velocities by electricity, the electrical target, the field telegraph and telephone, submarine mines and the steering of torpedoes, electrically, from the shore. Lieutenant Millis' description of the measuring of velocities by electricity is so good that we reproduce it:

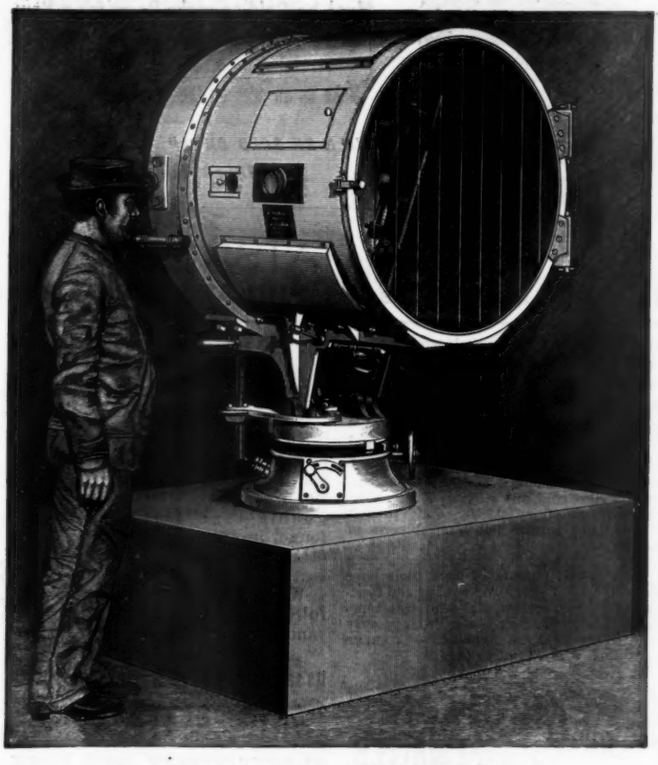
"Suppose a wire to be stretched across in front of the muzzle of the gun, and at a short distance from it, this wire forming part of a complete electric circuit, which includes also an electric battery and an electro-magnet. When the gun is fired this wire will be broken, the circuit interrupted, and the armature of the magnet released at the instant that the projectile reaches the wire in its flight. Now imagine a second wire stretched across the path of the shot, at a point one hundred feet in front of the first one, with a similar arrangement of electric circuit, battery and electro-magnet. The breaking of this second wire by the flying projectile will release the armature of the second magnet, and if the interval of time between the release of the two armatures can be determined, the velocity of the projectile is easily calculated. If the projectile has a velocity of 2,000 feet per second, and the wires are 100 feet apart, the interval of time will be one-twentieth of a second, and since it is necessary to know the velocity of the shot to within a few feet per second, an instrument capable of measuring the time interval to within the five-thousandth part of a second is required; and the instrument must also record its measurement, since the mind cannot conceive, and much less note, such a very brief period.

"These exacting conditions are completely fulfilled by the electric chronograph, which is an instrument embodying the two electro-magnets already referred to, together with a recording apparatus, and certain attachments for making necessary adjustments, etc. The armature of the first magnet is an iron rod about three feet long, which is suspended in a vertical position from the core of the magnet. The breaking of the first wire releases this rod, allowing it to fall, and when the second wire is broken the armature of the second electro-magnet, which is placed a short distance below the first, is also released, operating a sort of knife which strikes the side of the falling rod, and makes a cut or indentation. The distance of this cut from the end of the rod shows exactly how far the rod dropped while the shot was passing over the distance between the first and second wires, and the corresponding interval of time is readily computed from known laws of falling bodies. Knowing this interval and the distance between the two wires, the initial velocity of the projectile is easily determined."

"Electricity in the Household" is described in all its useful and ingenious appliances by A. E. Kennelly, Mr. Edison's chief electrician, who constructs the ideal house in which magicians at one time might have dreamed of living, but which has now become a possibility for the ordinary man.

And, finally, there is a chapter on "Electricity in Relation to the Human Body," by Doctor M. Allen Starr, one of the highest authorities on nervous diseases and their treatment by electricity and other means. Dr. Starr will receive the praise of every practical electrician for drawing the line sharp and clear between the legitimate uses of electricity in medicine and those uses which are merely devised to deceive credulous people. This chapter is calculated to be of benefit to those who are inclined to be deceived by the astounding promises of physicians who are really quacks, and unworthy of any consideration from scientific men.

The book, as a whole, is an illustration of what the great magazines are making possible in the line of valuable, accurate and scientific knowledge, placed within the reach of everybody at prices which are astounding, when one considers the great expenditure for illustrations and text in a book to which only the best men have been asked to contribute, and in which only the best work of skillful artists and engravers is represented. Copies of this book will be supplied by the ELECTRICAL REVIEW.



SHIP-OF-WAR'S SEARCH-LIGHT, 25,000 CANDLE-POWER.

CABLE LAYING.—LANDING THE SHORE END.

The Trolley.

It has been duly claimed by some of the objectors to the overhead system of electrical street car propulsion that the trolley wire, or conductor, which forms an important item in the expense of construction, would be the subject of great deterioration, owing to the constant bearing against it of the trolley wheel and that on each side of the switches and turnouts where, on passing, the trolley wheel sometimes jumps a little and comes, with considerable force, against the conductor, and there would be considerable trouble by breaking. Theoretically, doubtless, there is reason for such belief, but in practice it has failed to be of the magnitude which was supposed it would be. In one of the largest electric railway systems of the country, where the traffic is exceedingly heavy and there are many curves, turnouts, and crossings, there has been but one instance since the system was first put in operation where a trolley wire has broken. In this particular case the break occurred between two cross suspension wires, and in a place where the wire was subject to no influences other than a longitudinal strain. An investigation showed an evident flaw in the copper, and a crystalline appearance of the ruptured part. This led to a careful examination of the conductors at a curve where the heaviest traffic passes, and which is the oldest piece of construction on the entire system, but nothing indicating weakness or unusual wear could be seen.—*Lynn, Mass., Press.*

Madison Square Garden.

The electric light plant installed in the Garden by the Edison Company last Spring is giving perfect satisfaction, doing its work of illuminating the great amphitheatre, the Garden Theatre, restaurant and the new concert hall, without any trouble. Electrician Gilbert has recently put up an electrolier in the amphitheatre which carries 478 sixteen candle-power incandescent lamps. Eighteen Ward arc lamps are in use, current being supplied from the incandescent circuits.

The new concert hall is nearly completed and will be opened to the public very soon. The decoration of the interior is white at present, but this may be changed later. The ceiling is formed by 25 large panels, in the center of each of which will be placed a 100 candle-power incandescent lamp. The center panel will support an electrolier of novel design carrying 200 incandescent lamps.

The walls are decorated with trailing garlands in high relief. These will be studded with lamps. Two 20 light fixtures will be placed on the stage, which will also be illuminated by cornice lights from above.

Motors and Blowers.

The "C. & C." Electric Motor Company less than 12 months ago manufactured the first of its blower and motor combinations, with which most people versed in electrical appliances are now familiar. This apparatus was primarily designed for use in dynamo and engine rooms of steamers, and in other places where it is essential to produce a rapid and thorough ventilation, and where the space is circumscribed. Owing to the extreme compactness of the machine, it may be placed in the smallest room, and proves a most powerful exhaust. The apparatus was first used on the U. S. S. "Baltimore," and Captain Schley, commanding that ship, declared in a letter written to the "C. & C." Company that it gave "perfect satisfaction." The installation on the "Baltimore" has been followed by others on the "Chicago," "Charleston" and "Petrel," and three more blower combinations are now under construction by the "C. & C." Company for others of our new cruisers. The Italian navy, not to be left behind, ordered two of these blowers some few months ago, and after giving the apparatus a thorough test, have recently, through their agents in Milan, placed a further order with the "C. & C." Company for nine, including six of the No. 7 or largest size machines.

Locomotives for Boilers.

TO THE EDITOR OF ELECTRICAL REVIEW:

In looking over the last number of the ELECTRICAL REVIEW I noticed the paragraph relating to the use of a locomotive to supply steam to the engines of the Edison General Electric Company, at Schenectady, N. Y., and the opinion of old mechanics that it was the first time they had known of a locomotive being put to that use. I know of one other similar case.

Two years ago, I think, the boiler at the Hitchcock Manufacturing Company's shops exploded and while they were putting in new boilers a locomotive was used to supply steam to the engines. Thinking it may be of interest to some of your readers to know of such cases, I am, yours respectfully,

W. C. HINMAN.

Baltimore, Dec. 13, 1890.

Magnetism has Nothing to do With Hypnotism.

The experiments of Dr. Charcot, in Paris, have been cited to prove the magnet's mesmeric value. This celebrated specialist did obtain some striking results with a sensitive hypnotic subject under the influence of a magnet. Dr. Charcot not long after repeated the same experiments with the same subject, using, however, a dummy magnet made of painted wood, instead of the real one he had used before. He obtained the same hypnotic results, showing very clearly and positively that magnetism had "nothing to do with the case."

Undulations and Dots and Dashes.

Between one of the newspapers of New York and a Boston newspaper office a long-distance telephone wire runs, and this wire is used for both telegraphing and telephoning purposes.

KINDRED INTERESTS

R. T. White, 12 Pearl Street, Boston, is in receipt of a very complimentary letter regarding his Daisy rail chair, from Mr. F. G. L. Henderson, superintendent of the Newton, Mass., Street Railway Company, who operate three miles of track laid on these chairs.

The Columbia Incandescent Lamp Company, 1912–1914 Olive street, St. Louis, have sent us a handsome catalogue and price-list of their lamps. They claim for their products long life, maintenance of candle-power, high efficiency and even diffusion of light. The lamps are made to fit any socket. Mr. J. H. Rhotehamel is the president and manager of this company.

Alexander, Barney & Chapin, 20 Cortlandt street, New York, report large sales of alexite and fibrone products. The company's show windows have been tastefully arranged during the holidays, a feature being a series of mechanical toys operated by a miniature electric motor. The A. B. C. Company have secured the basement beneath their store in the Telephone Building and will instal an American electric elevator to run between the basement and the store.

Stanley & Hall, 32-34 Frankfort street, New York, have received a rather unusual communication. It is a letter from Yze Yuen Ming, an electrician in Shanghai, China, relating to the establishment by him of an importer's agency for the sale of Stanley & Hall's household electrical goods. The next thing we know we shall hear of this enterprising firm establishing branch houses on the Congo, Antarctic Circle or in Hoboken.

W. H. Gordon & Co., 115 Broadway, New York, are doing a large business in the Star Electrix specialties, for which they are the general selling agents. The demand for the sockets has been especially great, and the factory has been running to its utmost capacity to keep up with the orders. These goods besides being mechanically well made are of a high order electrically, and are giving universal satisfaction wherever they are used. Gordon & Company report that they are fully stocked with the cut-outs and switches, and are prepared to fill orders promptly.

The Universal Arc Lamp Company, 49 West 22d street, New York City, have received some very high testimonials regarding their lamps which are meeting with a large sale. Mr. Mendels, the general manager of the company, went over to Philadelphia last week to place several of his lamps on exhibition at the offices of the Edison General Electric Company and booked some orders as a recreation. A number of these lamps are burning all the time in the company's New York office. They are placed on 90, 100, and 110 volt circuits, and require but nine amperes of current.

"I advise all parents to have their boys and girls taught shorthand writing and typewriting. A stenographer who can typewrite his notes would be safer from poverty than a great Greek scholar."—CHARLES READE, on "The Coming Man."

5,000

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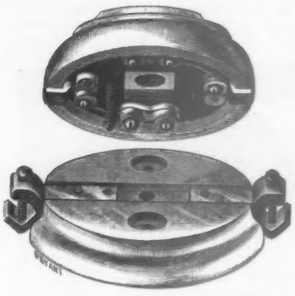

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Double Cylinder Battery.

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Weigh carefully these advantages.

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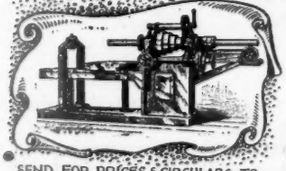

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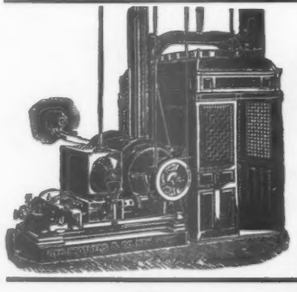

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ELECTRICAL PATENTS

INDEX OF INVENTIONS FOR WHICH LETTERS PATENTS OF THE UNITED STATES WERE ISSUED ON DECEMBER 16, 1890.

442,610 Station indicator; Louis Casper, Cheyenne, Wyoming.

442,617 Electric arc lamp; John E. Giles, Hazleton, Pa.

442,623 Electric trolley switch and trip; Richard C. Hopson, Saginaw, Mich.

442,649 Electric heater; Chas. H. Talmage, Kansas City, Mo.

442,654 Portable electric motor and cloth cutting machine; Elbert D. Weyburn, Chicago, Ill., assignor to the Weyburn Special Machine Company, same place.

442,666 Bracket for combined electric and gas lighting; John Gunn, New York, N. Y.

442,668 Regulation of electric motors; Edwin W. Rice, Jr., Lynn, Mass.

442,685 Electric light holder; Joseph B. Moore, Minneapolis, Minn.

442,705 Electric meter; Alexander W. Weston, St. Louis, Mo., assignor to the Emerson Electric Manufacturing Co., same place.

442,734 System of telegraphic and telephonic exchange; John R. Smith, Neosho, Mo., and Wallace Childs, Fort Smith, Ark.

442,744 Storage battery electric car. 442,745 Platform support for tram cars; John Stephenson, New York, N. Y.

442,746 Pendent cleat; Arthur R. Bush, Boston, Mass., assignor to Paine & Francis, same place.

442,799 Train telephone; Robert S. Carr, Hamilton, O., assignor of two-thirds to W. B. Carr and Geo. P. Stephenson, both of same place.

442,800 Reversing key; Edward A. Colby, Newark, N. J.

442,808 Telegraphy; Adolph G. Hummel, New York, and Frank A. Graham, Brooklyn, N. Y.

442,816 Safety device for overhead conductors; Robt. A. Morgan, Jr., Boston, Mass.

442,843 Electrical measuring instrument; Edw. Weston, Newark, N. J.

442,856 Means for reducing inductive disturbances in telephone circuits; John J. Carty, New York, N. Y.

442,868 Underground conduit for electric conductors; Josiah S. Du Bois, Camden, N. J.

442,870 Dynamo electric machine or motor; Nathan H. Edgerton, Philadelphia, Pa.

442,879 Metallic thermometer. 442,880 System for indicating thermometric records. 442,881 Means for the transmission of meteorological indications. 442,882 Multiple circuit closer. 442,883 Combined electric indicating and telephone system; Henry J. Haight, New York, N. Y.

442,932 Electric cooking apparatus. 442,933 Electric steam and hot water generator; Ernest Abshagen, Chicago, Ill., assignor, by direct and mesne assignments, of five-eighths to Geo. M. Clark, Henry M. Hubbard and William H. Hubbard, all of same place.

442,954 Method of welding metals electrically; Chas. L. Coffin, Detroit, Mich.

442,969 Portable electric lamp; Desmond G. Fitz Gerald and Arthur H. Hough, London, England, assignors to the Mining and General Electric Lamp Co., Limited, same place.

442,996 Electric switch; John O'Brien, New York, N. Y.

443,004 Trolley line switch. 443,005 Trolley line insulator; William M. Ramsey, Allegheny, Pa.

443,019 Magnetic shield for electric motors; Chas. J. Van Depoele, Chicago, Ill.

443,042 443,043 443,044 Magnetic ore separator; Geo. S. Finney, Chicago, Ill., assignor to the Rotary Magnetic Ore Separator Co., same place.

443,048 Method of protecting buildings from lightning; Nathaniel D. C. Hodges, Plainfield, N. J.

443,068 Electric cut-out; David J. Cartwright, Boston, and John S. Potter, Newton, Mass., said Cartwright assignor to said Potter.

443,074 Electric signaling device for moving vehicles; Otis J. Depp and Schuyler J. Munn, St. Louis, Mo., assignors of one-fourth to Peter M. Kling, same place.

443,081 Trolley switch for electric railways; John Jones, New York, N. Y., assignor of two-thirds to C. P. Stevens, Denver, Col.

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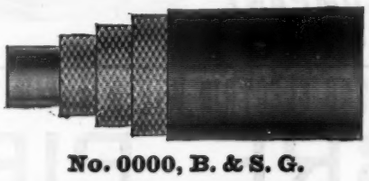

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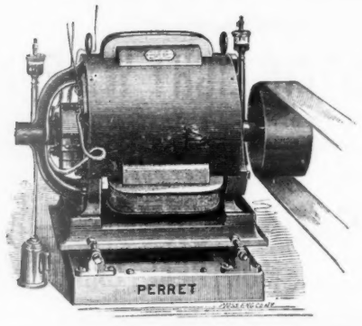

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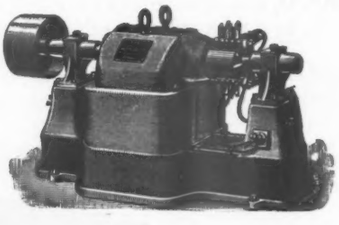

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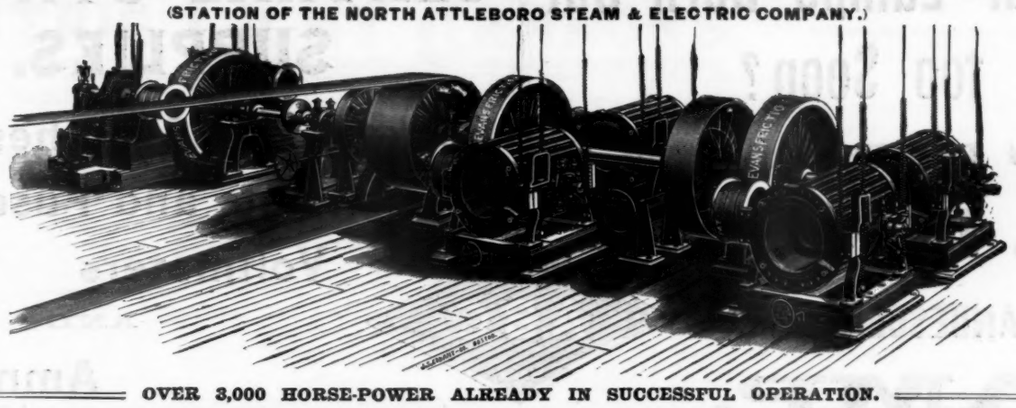

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C	8	.....	.....	.....	6.5	1½	5,000 FEET PER MINUTE.	530
C	.....	10	.....	.....	6.3	1½		530
C	.....	.....	.....	25	8.0	2		530
C	16	.....	.....	.....	12.6	2½		780
C	.....	20	.....	.....	12.5	2½		780
C	.....	.....	26	.....	13.0	2½		780
C	20	.....	.....	.....	15.0	3		990
C	.....	25	.....	.....	15.6	3		990
C	.....	.....	32	.....	15.0	3		990
C	.....	.....	.....	50	16.0	3		990
C	28	.....	.....	.....	21.0	4½		1,360

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G	.....	35	.....	.....	21.0	4	5,000 FEET PER MINUTE.	1,360
G	.....	.....	45	.....	21.0	4		1,360
G	.....	.....	.....	70	21.0	4½		1,360
H	40	.....	.....	.....	29.7	6		1,750
H	.....	50	.....	.....	30.0	6		1,750
H	.....	.....	64	.....	29.5	6		1,750
I	52	.....	.....	.....	38.0	8		2,200
I	.....	65	.....	.....	38.6	8		2,200
I	.....	.....	83	.....	38.0	8		2,200
K	64	.....	.....	.....	46.5	10		2,770
K	75	80	.....	.....	47.1	10		2,770
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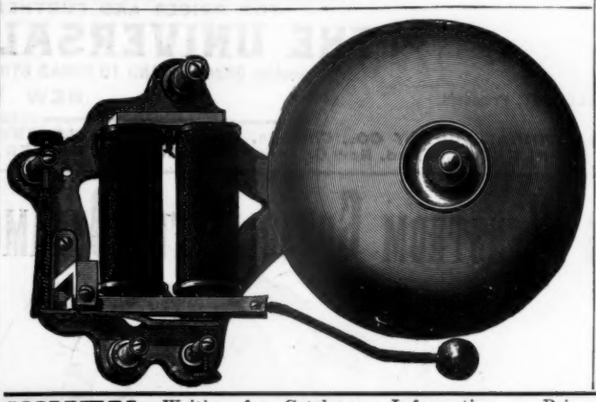

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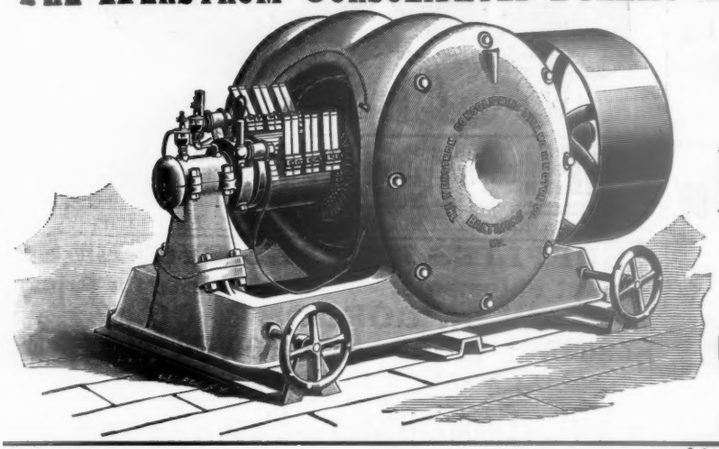

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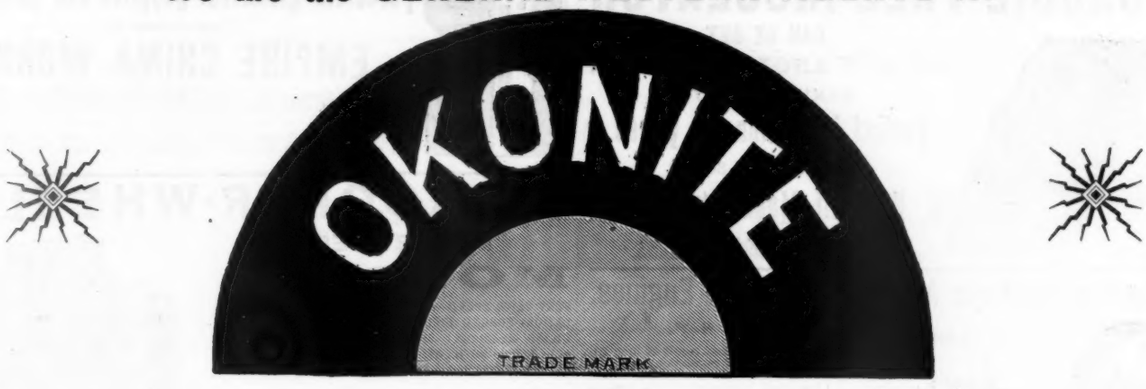

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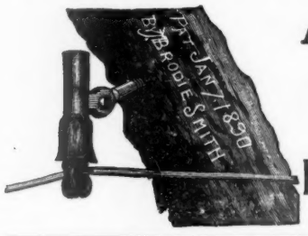

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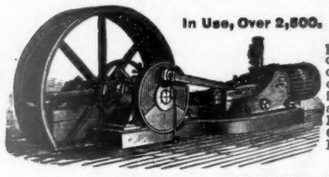

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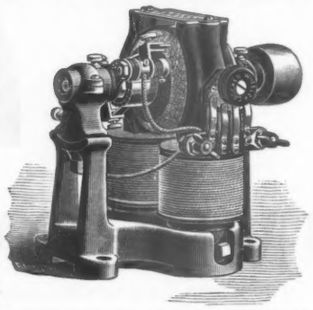

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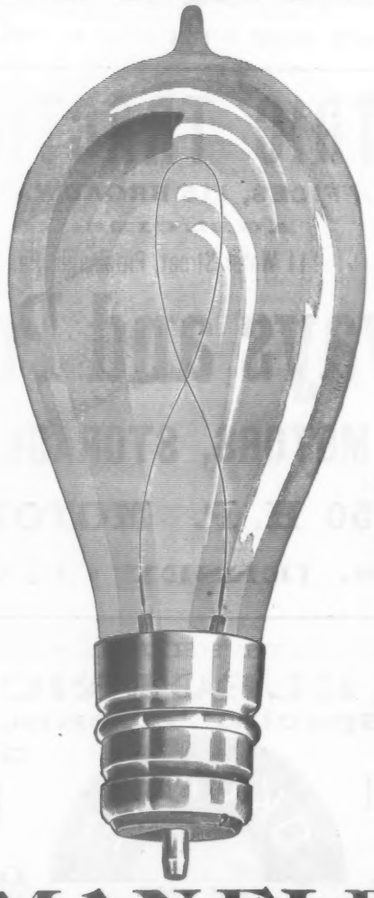

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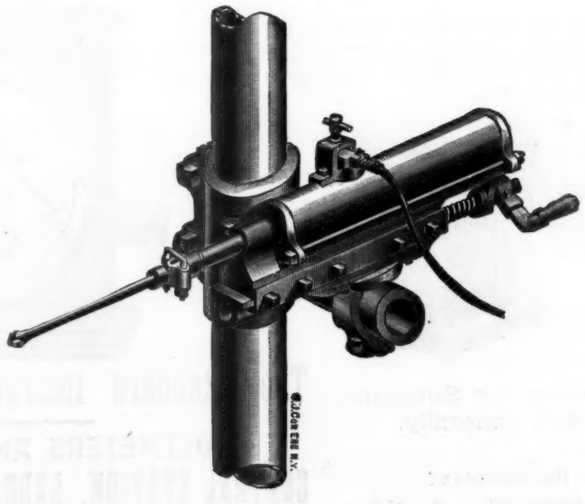

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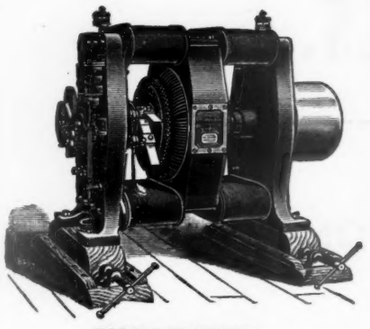

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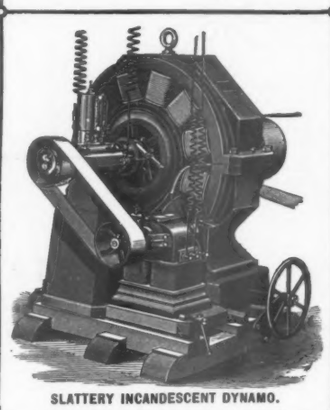

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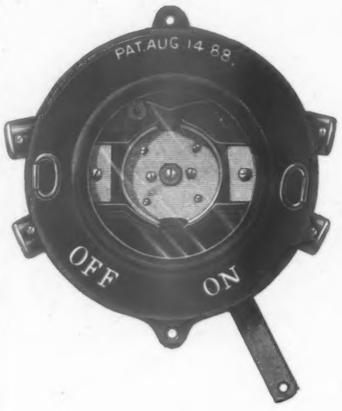

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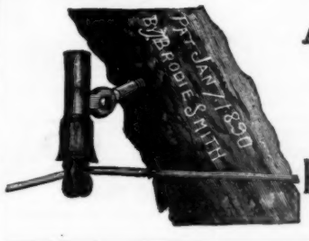

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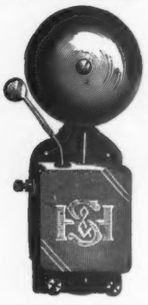

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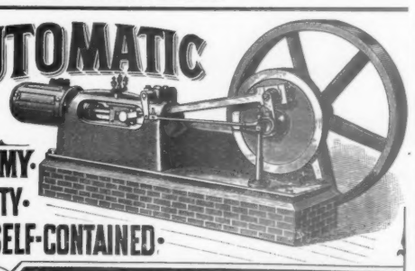

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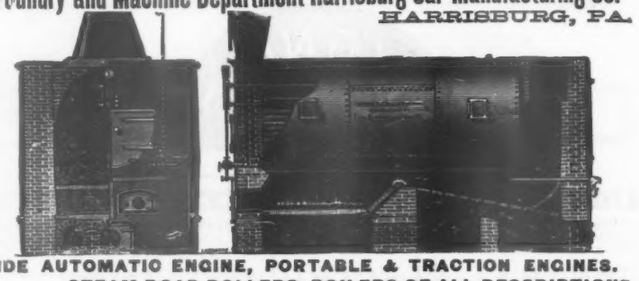

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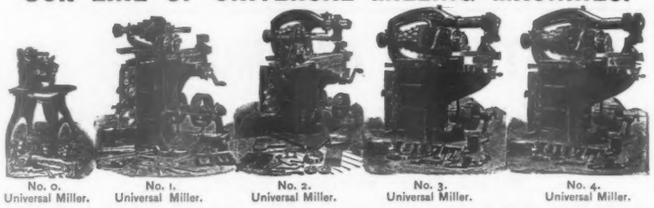

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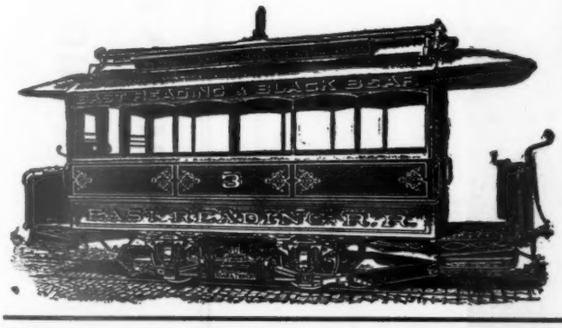

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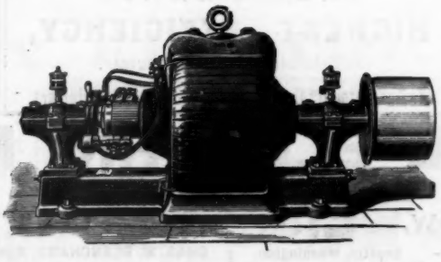

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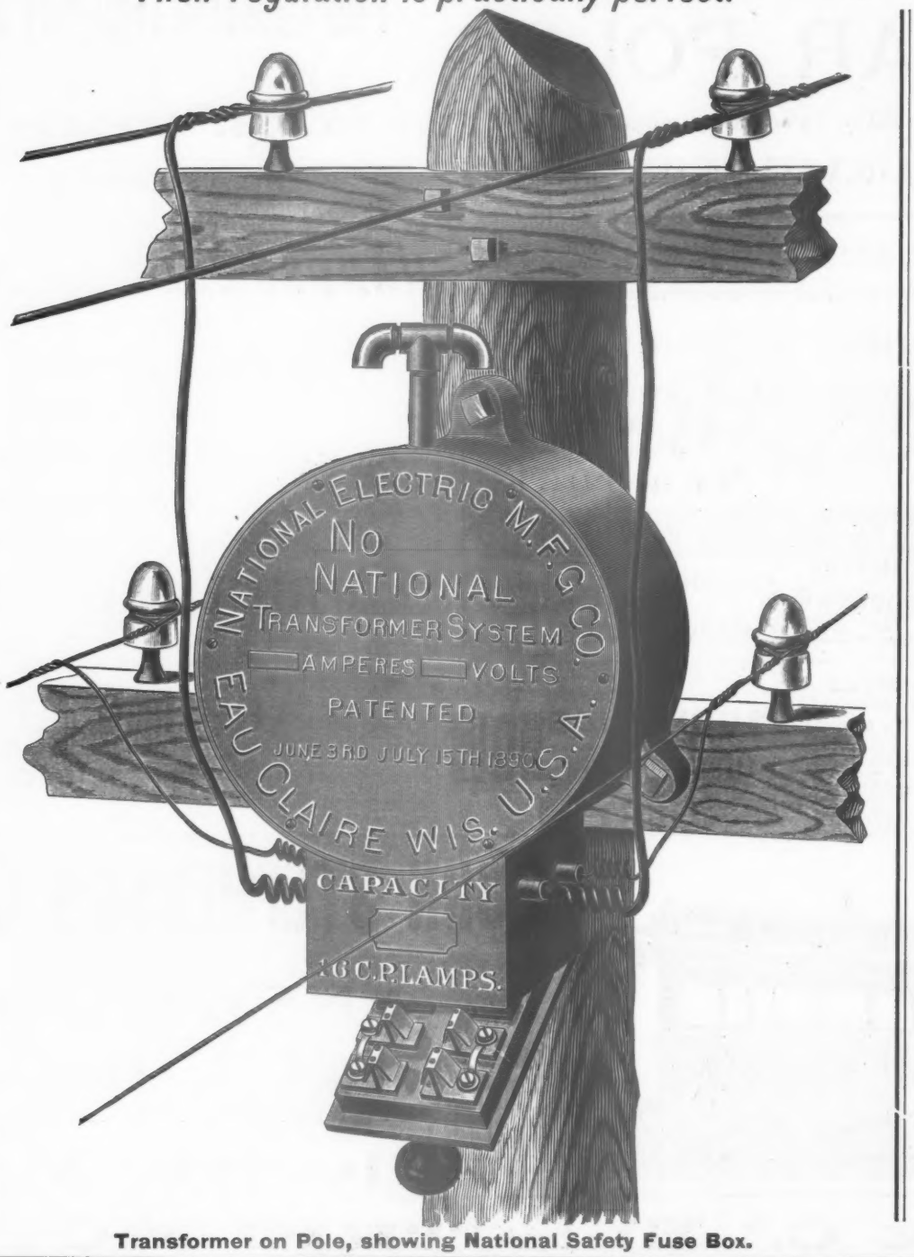

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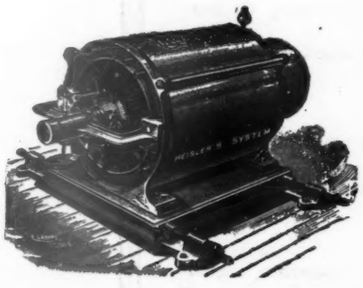

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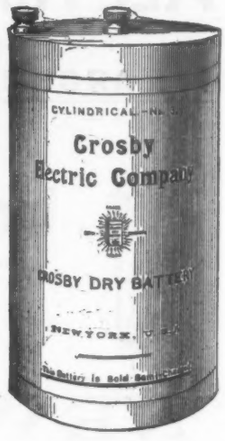

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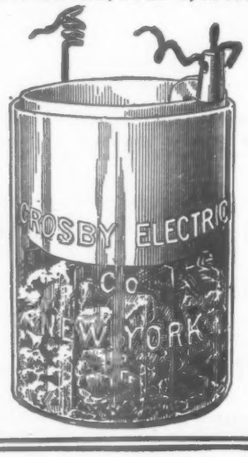

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